
INDUSTRY OVERVIEW

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SOURCE OF INFORMATION

We commissioned CIC, an independent market research consulting firm, to conduct a detailed analysis of and prepare a report on the tantalum and niobium metallurgy industry for the period from 2014 to 2023. We agreed to pay CIC a total fee of RMB905,000, which we believe reflects the market rate. CIC is a consulting company established in Hong Kong. Its services include industry consulting, commercial due diligence and strategy consulting. Its consultant team has been tracking the latest market trends in industrial, energy, chemical, healthcare, consumer goods, transportation, agriculture, internet and finance industries and has extensive experience in, and in-depth market knowledge of, the abovementioned industries.

CIC undertook both primary and secondary research through various resources. Primary research involved interviewing key industry experts and leading industry participants in the PRC tantalum and niobium metallurgy industry. Secondary research involved analysing data from various publicly available data sources, including PRC Government's press releases, company reports, independent research reports and CIC's internal database.

In compiling and preparing the CIC Report, CIC has adopted the following assumptions: (i) the PRC economic and industrial development is expected to maintain a steady growth rate in the next decade; (ii) related key industry drivers are expected to drive the growth of the PRC tantalum and niobium metallurgy industry in the forecast period, including growing demand from downstream industries, steady development of metallurgical technology, and recovering overseas markets; and (iii) there are no extreme force majeure events or introduction of industry regulations that will affect the market dramatically or fundamentally.

Our Directors are of the view that the information set forth in this section is reliable and not misleading as the information was extracted from the CIC Report. Our Directors confirm that, as at the Latest Practicable Date, after taking reasonable care, there had been no adverse change in the market information since the date of the CIC Report which may qualify, contradict or have an impact on the information in this section.

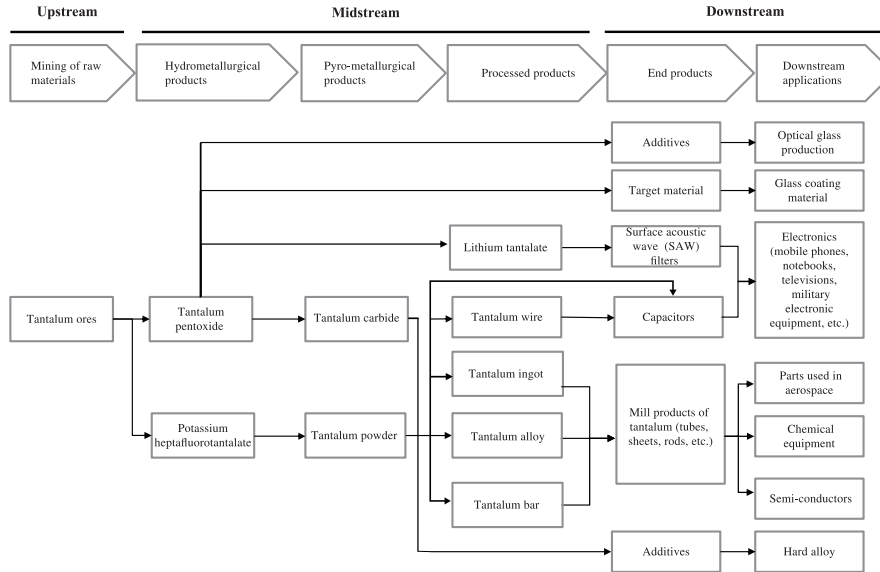
OVERVIEW OF THE GLOBAL AND PRC TANTALUM AND NIOBIUM METALLURGY INDUSTRY

The tantalum and niobium metallurgy industry refers to the manufacturing of tantalum- and niobium-based metallurgical products from tantalum ores and niobium ores. Tantalum, a silvery, dense, ductile solid at room temperature, is a corrosion-resistant rare metal with high thermal and electrical conductivity. Niobium, a soft, silvery, ductile solid at room temperature, is a corrosion-resistant rare metal with high melting point. Tantalum and niobium are similar to each other in terms of physical properties and often co-exist in the same minerals.

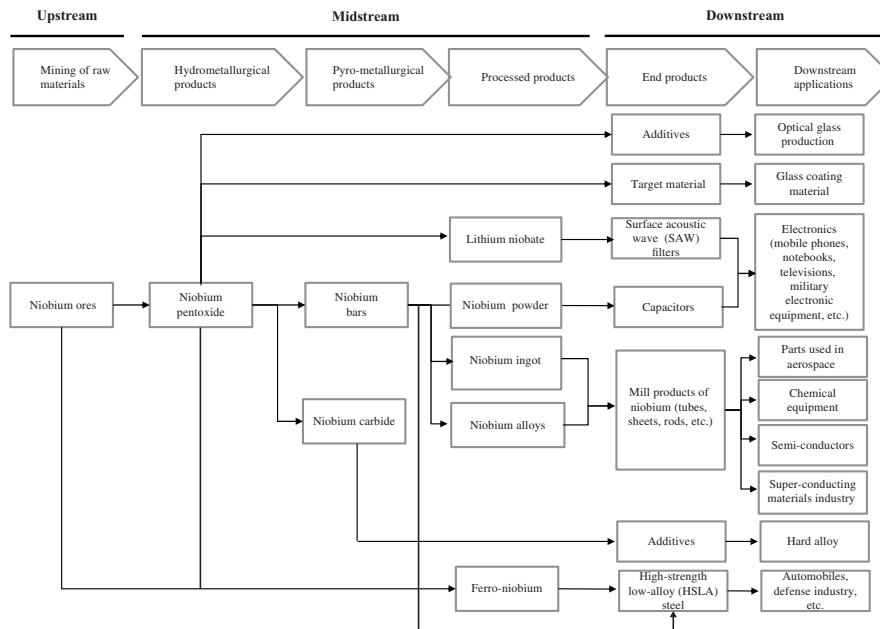
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Value Chain for the Global and PRC Tantalum and Niobium Metallurgy Industry

Typical tantalum-based products along the industry value chain:



Typical niobium-based products along the industry value chain:



Source: CIC

Tantalum and niobium often co-exist in ores in the forms of tantalum pentoxide and niobium pentoxide. Tantalum and niobium share some similar physical and chemical properties, and therefore have some overlapping downstream applications. The distinct applications of tantalum or niobium are due to some key differences in their characteristics. For example, tantalum is more widely used than niobium for production of high-performance capacitors due to its better electronic characteristics.

Tantalum ores and niobium ores are the principal raw materials for the production of pentoxide products including tantalum pentoxide (Ta_2O_5) and niobium pentoxide (Nb_2O_5), and potassium heptafluorotantalate (K_2TaF_7). These products are also referred to as hydrometallurgical (“濕法冶金”) products due to the metallurgical procedures involved in their production process. By undergoing pyro-metallurgical process, tantalum pentoxide, niobium pentoxide and potassium heptafluorotantalate can be

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further processed into pyro-metallurgical (“火法冶金”) products, including tantalum powder, tantalum carbide, niobium bars and niobium carbide. Pyro-metallurgical products can then be further processed into tantalum- and niobium-based processed products, including tantalum bars, niobium powder, niobium ingots, tantalum and niobium metal materials, alloys, and other industrial products.

Tantalum- and niobium-based metallurgical and processed products are essential in the downstream manufacture of various products used in high-tech industries, such as special alloys, chemical, electronic ceramics, aeronautics, aerospace, high-end electronics, defence and hard alloy. The relevant end products include electronic components, high-strength low-alloy steel, mobile phone lenses, camera lenses, artificial bones, high speed trains, aircraft carriers, optical glass, optical coating films and target materials.

Tantalum pentoxide and niobium pentoxide are widely used in a variety of downstream industries including (i) the high-end electronics industry for (a) high-performance glass used in camera lenses of mobile phones; (b) high-class capacitors and surface acoustic wave (SAW) filters used in valuable consumer electronics such as mobile phones; and (c) sputtering targets used in high-end integrated circuits (IC); (ii) the super-conducting materials industry for the manufacture of super-conducting magnetic coils used in magnetic resonance imaging (MRI) devices; (iii) the chemical industry for the manufacture of erosion-resistant materials used in a variety of infrastructure components, such as pipelines; and (iv) the steel industry for the manufacture of high-strength low-alloy steel products used in automobiles and defence equipment. All these industries have experienced and are expected to experience rapid growth from 2014 to 2023.

History and Development Trends of the Global and PRC Tantalum and Niobium Metallurgy Industry

The global tantalum and niobium metallurgy industry entered the industrial mass production stage in the 1950s when the PRC tantalum and niobium metallurgy industry was formed. The global and PRC tantalum and niobium metallurgy industry has experienced rapid expansion since 1991.

Within the global tantalum and niobium supply chain, African countries and Brazil supply ores to metallurgy companies in China, Germany, U.S., Thailand, and a few other countries for further production. China is the major exporter of tantalum- and niobium-based metallurgical products to the developed countries due to the fact that leading manufacturers of high-end tantalum- and niobium-based end products such as capacitors, special alloys used in aerospace and manufacturing of surface acoustic wave (SAW) filters, are located in developed countries. The tables below set forth the import volume and value of tantalum and niobium ores from overseas countries by China between 2016 and 2018, and the export volume and value of tantalum- and niobium-based metallurgical products from China during the same period:

Import Volume and Value of Tantalum and Niobium Ores in China

	HS code for global trade	Headings for the HS code	For the Year Ended 31 December						Major origins of ores in 2018 (in terms of weight)
			2016	2017	2018	2016	2017	2018	
			Import volume			Import value			
Tantalum and niobium ores	26159090	Niobium, tantalum concentrates and ores	7,428.7	7,275.3	7,222.3	121.2	144.3	185.2	Nigeria (51.5%) Brazil (13.8%) Rwanda (8.5%)

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Export Volume and Value of Major Tantalum- and Niobium-based Products in China

Product categories	HS code for global trade	Headings for the HS code	For the Year Ended 31 December						Major export destinations in 2018 (in terms of weight)
			2016			2017			
			2016	2017	2018	2016	2017	2018	
			Export volume			Export value			
			tonnes			USD million			
Tantalum-based metallurgical products	81032011	Tantalum powder, loose density less than 2.2 grams per cubic centimetre	123.3	126.1	155.7	41.4	46.3	66.7	United States (43.3%) Germany (42.0%)
	81032019	Other powder of tantalum	33.4	24.5	27.3	9.5	7.4	10.7	United States (66.5%) Malaysia (12.8%) Austria (95.9%)
	81032090	Other unwrought tantalum, including bars and rods obtained simply by sintering	0.2	1.7	0.6	0.05	0.5	0.3	
	81039011	Wire of tantalum, less than 0.5mm in diameter	47.8	47.0	63.4	20.1	18.6	29.5	Indonesia (30.1%) United states (23.1%) Austria (16.5%) Japan (28.3%)
	81039019	Other wire of tantalum	1.7	2.5	1.0	0.9	1.3	0.6	United States (23.0%) South Korea (11.1%) United States (63.7%) Hong Kong (10.1%)
	81039090	Other wrought tantalum and articles thereof, and tantalum crucible with tantalum ingot, bars, plate and other wrought products included	247.7	325.5	237.8	78.7	101.3	97.9	
Niobium-based metallurgical products	853221	tantalum capacitors	418.6	473.2	120.8	164.4	194.7	55.1	Hong Kong (48.6%)
	81129940	Wrought niobium and articles thereof	125.6	175.0	130.4	20.5	27.1	28.6	Finland (34.9%) United States (18.7%)
	81129240	Unwrought niobium and its powder, and unwrought niobium waste and scrap	95.4	146.4	118.4	5.0	9.1	8.8	Japan (45.0%) United States (35.4%)

Source: General Administration of Customs PRC, www.haiguan.info, CIC

Note: Tantalum- and niobium-based hydrometallurgical products are categorised into HS codes which include a number of other metallic compounds (codes including 28259090 “other metal oxides and hydroxides” and 28269090 “fluoroaluminate, other fluorine complex salt”), and the data for tantalum- and niobium-based hydrometallurgical products exclusive of other products is currently unavailable.

Global cooperation in the tantalum and niobium industry					
	Mining	Hydrometallurgical production	Pyro-metallurgical production	Processing and production of key end products	End applications
Tantalum value chain	African countries Over 70% of tantalum ores is produced and supplied by African countries including the Democratic Republic of the Congo, Rwanda, Nigeria, Sierra Leone, etc.	China Brazil Thailand Germany U.S. Chinese hydrometallurgical companies contribute over 78% of global shipment of primary products to the downstream in 2018, making China the largest producer and seller of primary products	China Germany U.S.	U.S. European countries (such as Germany, the United Kingdom and France) Japan Korea China	U.S. European countries (such as Germany, the United Kingdom and France) Japan Korea China
Niobium value chain	Brazil Brazil contributes over 90% of total niobium supply in terms of niobium weight, and over 90% of its niobium output is produced into ferroniobium; the rest is supplied to metallurgical and processing companies				

The market size of the global tantalum and niobium metallurgy industry is normally measured by the production volume of tantalum- and niobium-based hydrometallurgical products, as (1) these products are the direct output produced from the raw materials and input into the downstream metallurgical and processing production, (2) these tantalum- and niobium-based hydrometallurgical products are relatively consistent and standard in terms of content of tantalum and niobium, which provides a consistent calculation basis that is not influenced by various concentration levels of tantalum and niobium in the pyro-metallurgical products and processed products, and (3) if the market size of the global tantalum and niobium metallurgy industry also takes into account the production volume of pyro-metallurgical products and/or processed products, there will be duplicate calculation for the market size.

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According to CIC, the global production volume of tantalum- and niobium-based hydrometallurgical products grew from approximately 4,521.3 tonnes in 2014 to 7,397.9 tonnes in 2018, and is expected to increase to 9,469.9 tonnes in 2023, representing a CAGR of 5.1%. Of the global production volume, approximately 63.7% of the production volume in 2018 was for external sales while the rest was for in-house consumption, as it is quite common for the industry-leading companies to operate in several segments along the value chain, and rely heavily upon their in-house production of tantalum- and niobium-based hydrometallurgical products to support the further production of pyro-metallurgical and processed products, which in turn enables them to have higher control of the whole value chain.

In contrast to overseas markets, there are approximately 15 metallurgy companies in China which are in the business of selling tantalum- and niobium-based hydrometallurgical products to external clients both in domestic market and overseas market in 2018, and the overall tantalum and niobium value chain in the Chinese market has not been vertically integrated to a high extent. The Chinese tantalum and niobium metallurgy companies have not been much vertically-integrated due to the fact that only a limited number of enterprises have developed both hydrometallurgical and pyro-metallurgical techniques. Most of the tantalum- and niobium-based metallurgy companies in China are currently private companies which in general have a shorter history, and they focus on producing either tantalum- and niobium-based hydrometallurgical or pyro-metallurgical products.

The total production volume of tantalum- and niobium-based hydrometallurgical products in China increased from approximately 2,462.6 tonnes in 2014 to 4,336.6 tonnes in 2018, and is expected to reach 6,168.9 tonnes in 2023 presenting a CAGR of 7.3%. Within this market, the production volume for external sales grew from approximately 2,090.0 tonnes in 2014 to 3,690.0 tonnes in 2018 and is expected to reach 5,210.1 tonnes in 2023 representing a CAGR of 7.1%. This also implies that the scale of production for in-house consumption by pyro-metallurgical and processing companies in China is rather limited and expected to increase as some companies are pushing forward vertical integrations.

Compared with metallurgy companies located in developing countries such as Brazil, Thailand, South Africa and a few other places, the PRC-based tantalum and niobium hydrometallurgy companies have comparable labour cost levels. The PRC-based companies compete on the following fronts with metallurgy companies located in developing countries, including those in close proximity to the mines: (i) the production capability of the PRC-based companies as the total production volume of tantalum- and niobium-based hydrometallurgical products in China amounted to 4,336.6 tonnes in 2018, representing 58.6% of the global production volume, which is comparable to the proportion of the global consumption of tantalum and niobium ores used to produce tantalum- and niobium-based hydrometallurgical products in China; (ii) the readily available auxiliary raw materials such as acids, ammonia, and other chemical materials provided by domestic suppliers; and (iii) the well-developed logistics networks in China that facilitate the global trade of relevant products both by vessel and air transportation.

According to CIC, the global and PRC tantalum and niobium metallurgy industry have considerable growth prospects in the following regards:

- *Industrial upgrade.* The PRC Government has published policies to reduce excessive capacity (去產能), including requirements to shut down small-size enterprises. These policies and requirements are likely to accelerate consolidation of the industry, compelling the market participants to increase investments on upgrading manufacturing technologies, and expand their production capacity.
- *Growing demand for high-purity products.* The rapid development of downstream industries of high-purity products, such as high-end electronics industry and super-conducting materials industry, will likely drive the demand for high-purity tantalum- and niobium-based metallurgical products. For details, please refer to the paragraph headed “Value chain for the global and PRC tantalum and niobium metallurgy industry” in this section.
- *Ever-expanding applications.* As a variety of innovative materials have been or will be developed from tantalum- and niobium-based metallurgical products such as surface acoustic wave (SAW) filters, in line with China’s increasing investment in research and development for new materials, the applications of tantalum- and niobium-based metallurgical products are expected to expand in the next decade, which will create new demand for tantalum- and niobium-based metallurgical products.

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- *Investments in overseas tantalum ores and niobium ores.* As over 85% of tantalum ores and niobium ores consumed by PRC enterprises are imported from overseas, participants in the PRC tantalum and niobium metallurgy industry are seeking opportunities to invest in overseas tantalum-niobium mines. As such, the PRC enterprises will be able to further secure the supply of raw materials for ensuring the timely delivery of products and expanding production capacity.

Entry Barriers for the Global and PRC Tantalum and Niobium Metallurgy Industry

Both the global and PRC tantalum and niobium metallurgy industry have high entry barriers, including:

- *Capital requirement.* Substantial initial investment is required to acquire land use rights, construct required plants, purchase and install production facilities, as well as to recruit skilled personnel.
- *Mandatory qualifications.* A company engaged in the manufacturing of tantalum- and niobium-based metallurgical products needs to obtain various permits and licences pursuant to relevant laws and regulations, such as work safety permit, hazardous chemicals registration certificate and special equipment use registration certificate.
- *Environmental protection requirements.* The PRC Government pays special attention to environmental protection issues. Before commencing commercial production, a manufacturer of tantalum- and niobium-based metallurgical products needs to pass environmental assessment procedures, obtain approvals from relevant environmental protection authorities, and continuously comply with environmental requirements during its operation and production.
- *Technology barriers.* To meet differentiated customer demand for products with different physical properties and other specifications, a manufacturer of tantalum- and niobium-based metallurgical products needs to research and develop innovative metallurgical technologies. However, only a few companies are able to produce tantalum- and niobium-based metallurgical products that meet the increasingly rigorous technical requirements and the continuously rising performance requirements and standards.
- *Availability of raw materials.* Tantalum ores and niobium ores are the key raw materials for the manufacturing of tantalum- and niobium-based metallurgical products. Access to a stable supply of tantalum ores and the niobium ores is critical to the timely delivery of products to customers.

Regulatory Environment for the PRC Tantalum and Niobium Metallurgy Industry

The PRC Government has introduced a number of policies and initiatives to encourage the development of the tantalum and niobium metallurgy industry in recent years. MIIT promulgated the 13th Five-Year Plan on the Non-ferrous Metals Industry (有色金屬工業十三五發展規劃) in October 2016 to increase the investment in research and development for key manufacturers in the non-ferrous metal industry. The NDRC, MOF and MOFCOM have promulgated the Catalogue of Recommended Technologies and Products to be Imported (鼓勵進口技術和產品目錄) in September 2016, pursuant to which manufacturing technology for tantalum- and niobium-based special alloys and the coating technologies have been listed, and PRC enterprises are eligible to apply for certain government subsidies when importing such technologies. As a result, it is expected that PRC enterprises will import tantalum- and niobium-based special alloys and coating technologies, which may in turn drive the technology upgrade of the PRC tantalum and niobium metallurgy industry. New advancements in manufacturing technology for tantalum- and niobium-based special alloys have driven and will continue to drive the need for tantalum- and niobium-based hydrometallurgical products in the PRC market. In addition, the Made in China 2025 Initiative (中國製造2025) introduced by the PRC Government in 2015 aims to facilitate the growth of tantalum and niobium metallurgy industry by encouraging investment in research and development of advanced technologies for the production of tantalum- and niobium-based metallurgical products. Moreover, the PRC Government is expected to promulgate policies to offer more effective protection of intellectual properties to promote intelligent and green manufacturing.

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THE PRC TANTALUM- AND NIOBIUM-BASED METALLURGICAL PRODUCTS MARKET

The tantalum and niobium metallurgical market has been a niche market. According to the CIC Report, there were only approximately 30 market players (including metallurgy companies in the hydrometallurgical, pyro-metallurgical and processed products segments) in the tantalum and niobium metallurgy industry in China in 2018 with 15 major market players that contributed over 85% of the total production volume in their relevant segments in China in 2018 and the remaining market players have relatively smaller scale that cannot compete with such major market players.

The table below sets forth the business scope and product portfolio of the 15 major market players in the tantalum and niobium metallurgy industry in China in 2018:

Major market players	Hydrometallurgical products	Pyro-metallurgical products	Processed tantalum and niobium products
	Major types of products produced		
The Company	<ul style="list-style-type: none"> Tantalum pentoxide, niobium pentoxide, potassium heptafluorotantalate 		
Company One	<ul style="list-style-type: none"> Tantalum pentoxide, niobium pentoxide, potassium heptafluorotantalate 		
Company Two	<ul style="list-style-type: none"> Tantalum pentoxide, niobium pentoxide, potassium heptafluorotantalate 		
Company Three	<ul style="list-style-type: none"> Tantalum pentoxide, niobium pentoxide, potassium heptafluorotantalate 	<ul style="list-style-type: none"> Tantalum powder, tantalum carbides, niobium bars 	<ul style="list-style-type: none"> Tantalum bars, tantalum wires, niobium powder
Company Four	<ul style="list-style-type: none"> Niobium pentoxide 		
Company Five	<ul style="list-style-type: none"> Tantalum pentoxide, niobium pentoxide, potassium heptafluorotantalate 	<ul style="list-style-type: none"> Tantalum powder, tantalum carbides, niobium bars 	<ul style="list-style-type: none"> Tantalum bars, tantalum wires, tantalum ingot, tantalum alloy, niobium powder, niobium ingot
Company Six	<ul style="list-style-type: none"> Tantalum pentoxide, niobium pentoxide, potassium heptafluorotantalate 	<ul style="list-style-type: none"> Tantalum powder 	<ul style="list-style-type: none"> Tantalum bars
Company Seven (Note 2)		<ul style="list-style-type: none"> Tantalum powder, tantalum carbides, niobium bars 	<ul style="list-style-type: none"> Tantalum bars, niobium powder
Company Eight		<ul style="list-style-type: none"> Tantalum powder, tantalum carbides, niobium bars 	<ul style="list-style-type: none"> Tantalum bars, tantalum ingot, niobium ingot
Company Nine (Note 2)	<ul style="list-style-type: none"> Tantalum pentoxide, niobium pentoxide, potassium heptafluorotantalate 	<ul style="list-style-type: none"> Tantalum powder 	
Company Eleven	<ul style="list-style-type: none"> Tantalum pentoxide, niobium pentoxide, potassium heptafluorotantalate 		
Company Twelve	<ul style="list-style-type: none"> Tantalum pentoxide, niobium pentoxide, potassium heptafluorotantalate 		
Company Thirteen		<ul style="list-style-type: none"> Niobium bars 	<ul style="list-style-type: none"> Tantalum ingot, niobium ingot
Company Fourteen			<ul style="list-style-type: none"> Tantalum ingot, tantalum wires, niobium wires
Company Fifteen		<ul style="list-style-type: none"> Niobium bars 	<ul style="list-style-type: none"> Tantalum ingot, tantalum wires, niobium ingot, niobium wires

Notes:

- These major market players include producers of hydrometallurgical, pyro-metallurgical and processed products, which are listed in arbitrary order.
- Such major market players reduced their production volume in 2019 because they were relocating their production facilities.

The value chain of the tantalum and niobium metallurgy industry comprised raw materials, hydrometallurgical products, pyro-metallurgical products, processed products as well as end products and downstream applications. Hydrometallurgical products play an important role in the tantalum and niobium metallurgy industry as all pyro-metallurgical products are produced from hydrometallurgical products and hydrometallurgical products can also be used directly in production of some processed products or end products. Given (1) we were the largest producer of tantalum- and niobium-based hydrometallurgical products in China for FY2016, FY2017 and FY2018 in terms of total annual production volume for external sales, (2) we sold full range of hydrometallurgical products directly to producers of pyro-metallurgical products, processed products and end products or indirectly after our products were further processed by our customers, and (3) we sold some pyro-metallurgical products and processed products upon customers' request, we were one of the 15 major market players in the tantalum and niobium metallurgy industry in China in 2018.

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THE PRC TANTALUM- AND NIOBIUM-BASED HYDROMETALLURGICAL PRODUCTS MARKET

Raw Materials Supply

Tantalum ores and niobium ores are the key raw materials for the production of tantalum pentoxide, niobium pentoxide and potassium heptafluorotantalate. According to CIC, over 85% of tantalum ores and niobium ores consumed in China are imported from African and South American countries, such as Nigeria, Rwanda, Sierra Leone, the Democratic Republic of the Congo, and Brazil.

The grades of tantalum ores and niobium ores can vary significantly in terms of different tantalum and niobium concentration levels. The grade of ores is determined according to industry-wide tests such as paper chromatography (紙上色層分析法) and ICP-MS method (電感耦合等離子體原子發射光譜法) on the tantalum and niobium concentration levels, which are universally acceptable by the global industry participants. The following table presents a brief summary of grade and specific pricing policy for the commonly-traded tantalum and niobium ores:

	<u>Contents of tantalum pentoxide</u>	<u>Contents of niobium pentoxide</u>	<u>Pricing practice in the industry</u>
Tantalum ores	15% to 35%	18% to 30%	Unit price of tantalum pentoxide multiplied by the weight of tantalum pentoxide; the value of niobium pentoxide contained in the ores is normally not included in the price.
Niobium ores	3% to 20%	20% to 60%	Unit price of niobium pentoxide multiplied by the total weight of tantalum pentoxide and niobium pentoxide contained in the ores; as tantalum pentoxide is significantly more expensive, the unit price of niobium ores can vary greatly depending on the content of tantalum pentoxide within the ores.

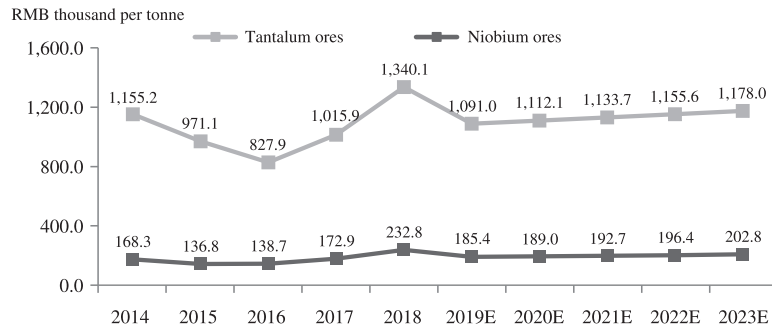
In general, high-grade tantalum and niobium ores are more ideal for producing high-purity pentoxides, as there are fewer impurities in the ores. However, the supply of high-grade ores is not always as stable as that of common ores. The metallurgy companies both in China and overseas countries have all evolved to cope with various grades of ores after decades of technological advance and practice. As a result, the difference in the grades of ores will not lead to significant variance in product purity, as the purity is mostly determined by the production process and technique involved. In fact, metallurgy companies in China all have similar access to the global supply of tantalum and niobium ores, and there are usually no significant differences in the quality of ores purchased by these companies in the long term, while leading players may have advantages in procuring high-grade ores occasionally due to their capital strength in making fast down payments.

The average market price for imported tantalum ores decreased significantly from RMB1.2 million per tonne in 2014 to RMB0.8 million per tonne in 2016, primarily due to the increasing supply from African countries and relatively weakening demand from downstream metallurgy industries. The average market price started to rebound to RMB1.0 million per tonne in 2017 and reached RMB1.3 million per tonne by the end of 2018, which was attributable to increasing demand for tantalum-based products. As the demand for tantalum-based products stabilised, the price of tantalum ores is expected to decline in 2019, and gradually increase from 2020 to 2023, reaching RMB1.2 million per tonne in 2023. For the same reasons, the average market price for imported niobium ores declined from RMB168,300 per tonne in 2014 to RMB138,700 per tonne in 2016, and started to slightly rebound to RMB172,900 per tonne in 2017 and reached RMB232,800 per tonne by the end of 2018. The price of niobium ores is expected to decline in 2019, and remain relatively stable and reach RMB202,800 per tonne in 2023.

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The following graph illustrates the average market prices for imported tantalum ores and niobium ores for the periods indicated:

PRC average market prices for imported tantalum and niobium ores⁽¹⁾ (2014–2023E)



Source: China Tantalum and Niobium Association, CIC

Note:

- (1) PRC average market prices for imported tantalum ores and niobium ores refer to the average imported prices for tantalum ores containing a minimum of 30.0% of tantalum pentoxide, and niobium ores containing a minimum of 50.0% of niobium pentoxide and 5.0% of tantalum pentoxide, respectively, including cost, insurance, and freight expenses.

Market Size and Forecast in terms of Production Volume for External Sales

Pentoxide

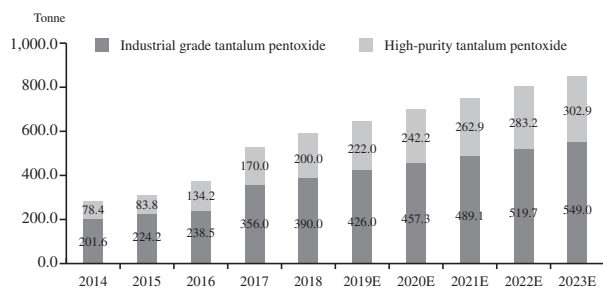
The production volume of tantalum pentoxide in China increased from 280.0 tonnes in 2014 to 590.0 tonnes in 2018, representing a CAGR of 20.5%, and is expected to further increase to 851.9 tonnes in 2023, representing a CAGR of 7.6%, primarily due to the growing demand from various downstream industries. The production volume of industrial grade tantalum pentoxide increased from 201.6 tonnes in 2014 to 390.0 tonnes in 2018 and is expected to further expand and reach 549.0 tonnes by 2023, representing a CAGR of 7.1% between 2018 and 2023, which is primarily due to the recovery of various downstream industries such as the aeronautical industry, aerospace industry and high-end electronics industry. The production volume of high-purity tantalum pentoxide increased from 78.4 tonnes in 2014 to 200.0 tonnes in 2018, representing a CAGR of 26.4%, and is expected to further increase to 302.9 tonnes in 2023, representing a CAGR of 8.7%, primarily driven by the favourable PRC Government policies and growing demand for certain high-tech electronic components manufactured from high-purity tantalum pentoxide.

The production volume of niobium pentoxide in China increased from 1,352.0 tonnes in 2014 to 2,250.0 tonnes in 2018 representing a CAGR of 13.6%, and is expected to further increase to 3,248.9 tonnes in 2023, representing a CAGR of 7.6%, primarily due to the growing demand from downstream industries, such as the special alloys industry, and upgrades to metallurgy technology. The production volume of industrial grade niobium pentoxide increased from 1,095.1 tonnes in 2014 to 1,580.0 tonnes in 2018 and is expected to further grow and reach 2,182.6 tonnes by 2023, representing a CAGR of 6.7% between 2018 and 2023. The production volume of high-purity niobium pentoxide increased from 256.9 tonnes in 2014 to 670.0 tonnes in 2018, representing a CAGR of 27.1%, and is expected to further increase to 1,066.3 tonnes in 2023, representing a CAGR of 9.7%, primarily driven by favourable PRC Government policies and development of downstream industries, such as high-speed

INDUSTRY OVERVIEW

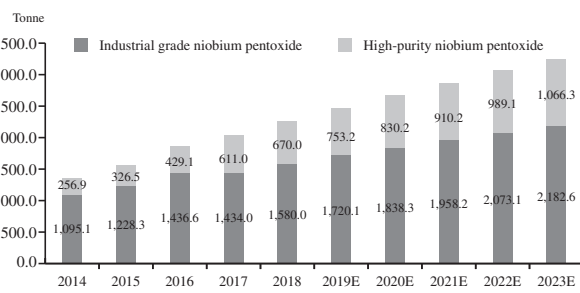
trains, aerospace and aeronautical industries. The following charts illustrate the market size for the PRC tantalum pentoxide market and PRC niobium pentoxide market in terms of production volume for the periods indicated:

PRC tantalum pentoxide market size by production volume (2014–2023E)



Source: China Tantalum and Niobium Association, CIC

PRC niobium pentoxide market size by production volume (2014–2023E)



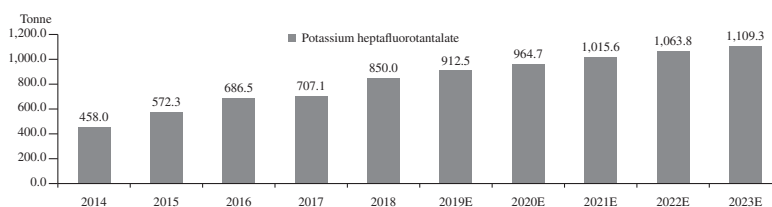
Source: China Tantalum and Niobium Association, CIC

Potassium heptafluorotantalate

The production volume of potassium heptafluorotantalate in China increased from 458.0 tonnes in 2014 to 850.0 tonnes in 2018, and is expected to increase to 1,109.3 tonnes in 2023, representing a CAGR of 5.5% between 2018 and 2023. Such a strong growth is primarily because its downstream product, namely tantalum powder, is applied in increasing applications in high-tech fields including high temperature resisting special alloys in the aerospace industry, corrosion-resistant alloys in the offshore engineering equipment manufacturing industry and target materials in the semi-conductor manufacturing industry.

The following chart illustrates the market size for the PRC potassium heptafluorotantalate market in terms of production volume for the periods indicated:

PRC potassium heptafluorotantalate market size by production volume (2014–2023E)



Source: China Tantalum and Niobium Association, CIC

Average Selling Price and Forecast

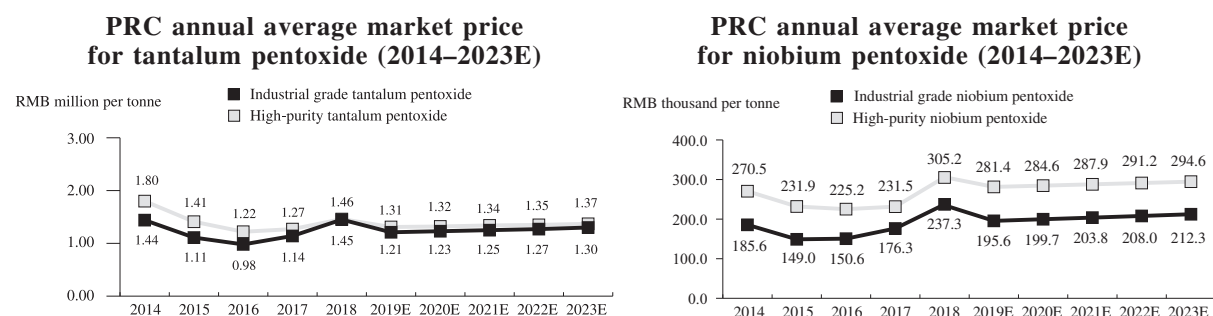
Pentoxide

The average selling prices for industrial grade tantalum pentoxide and industrial grade niobium pentoxide in China decreased from RMB1.4 million per tonne and RMB185,600 per tonne in 2014, respectively, to RMB1.0 million per tonne and RMB150,600 per tonne in 2016, respectively. Such downward price trend was mainly due to the expansion of production capacity of producers of such products in line with the advances in production techniques and the decline in price of tantalum ores and niobium ores for the same period. The average selling prices for industrial grade tantalum pentoxide and industrial grade niobium pentoxide in China increased to RMB1.5 million per tonne and RMB237,300 per tonne in 2018, respectively, mainly driven by the growing demand from various downstream industries in line with the recovering global economy. According to CIC, the average selling prices of industrial grade tantalum pentoxide and industrial grade niobium pentoxide in China are expected to slightly decline to RMB1.2 million per tonne and RMB195,600 per tonne in 2019, respectively, which is in line with the decline in price of tantalum ores and niobium ores, and then reach RMB1.3 million per tonne and RMB212,300 per tonne, respectively, in 2023.

INDUSTRY OVERVIEW

The average selling prices for high-purity tantalum pentoxide and high-purity niobium pentoxide in China decreased from RMB1.8 million per tonne and RMB270,500 per tonne in 2014, respectively, to RMB1.2 million per tonne and RMB225,200 per tonne in 2016, respectively. Such downward price trend was mainly due to the continuous decline in prices for tantalum ores and niobium ores as a result of increased global supply from African countries and relatively stable demand for metallurgical products from downstream industries that were de-stocking their inventories built up in the previous years. The average selling prices for high-purity tantalum pentoxide and high-purity niobium pentoxide in China increased to RMB1.5 million per tonne and RMB305,200 per tonne in 2018, respectively, driven by rising demand from downstream industries. Such prices are expected to decline to RMB1.3 million per tonne and RMB281,400 per tonne in 2019, respectively, mainly due to an expected stable supply of tantalum ores and niobium ores in the upstream industries. Afterwards, such prices are expected to increase to RMB1.4 million per tonne and RMB294,600 per tonne in 2023, respectively, due to a continuously growing demand from downstream industries including electronics, optical glass manufacturing and superconducting materials.

The following graph illustrates the average selling prices for tantalum pentoxide and niobium pentoxide in China for the periods indicated:

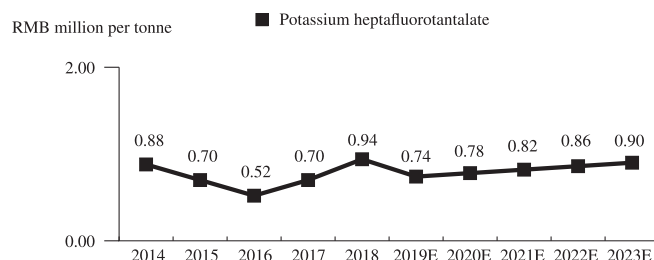


Source: Asianmetal.com, CIC

Potassium heptafluorotantalate

The average selling price for potassium heptafluorotantalate in China decreased from RMB0.9 million per tonne in 2014 to RMB0.5 million per tonne in 2016, in line with the decline in price of tantalum ores and niobium ores for the same period. The average selling price for potassium heptafluorotantalate in China increased from RMB0.5 million in 2016 to RMB0.9 million in 2018, in line with the price increase in tantalum ores and niobium ores from 2016 to 2018. The average selling price for potassium heptafluorotantalate in China is expected to drop in 2019 and then rebound slightly, mainly due to the expected stable and sufficient supply of tantalum ores and niobium ores in the global and PRC markets.

The following graph illustrates the average selling price for potassium heptafluorotantalate in China for the periods indicated:



Source: China Tantalum and Niobium Association, CIC

INDUSTRY OVERVIEW

Sales Volume and Inventory Trend

As the production of tantalum- and niobium-based metallurgical products is capital-intensive, given that the market prices of high-value ores are controlled by international suppliers and almost no credit payment is accepted by them, PRC producers of tantalum- and niobium-based metallurgical products have to maintain their inventory at reasonable levels to expedite the operational cycle and lower financial expenses. The total sales volume of tantalum- and niobium-based hydrometallurgical products in China was 2,881.9 tonnes, 3,229.2 tonnes and 3,750.0 tonnes for FY2016, FY2017 and FY2018, respectively, while the production volume for external sales, which includes the sales volume and net change in inventory, was 2,924.9 tonnes, 3,278.1 tonnes and 3,690.0 tonnes, respectively. As the market prices kept recovering between 2016 and 2017, the industry sales volume was 1% to 2% lower than the actual production volume. Considering that the gap between sales volume and production volume was insignificant between 2016 and 2017, there was no obvious overstock of tantalum- and niobium-based hydrometallurgical products from PRC manufacturers, according to CIC. In 2018, due to the rising demand for tantalum- and niobium-based hydrometallurgical products, sales volume exceeded production volume.

Competitive Landscape

The PRC tantalum- and niobium-based hydrometallurgical products market is competitive and relatively concentrated, with around 15 market players and the top five players accounting for 82.9% of the market share in terms of production volume for external sales in 2018. We are one of the earliest non-state owned PRC-based market participants and ranked first among producers of tantalum- and niobium-based hydrometallurgical products in China in 2018 in terms of annual production volume for external sales, accounting for 35.8% of the market share.

The following table illustrates certain background information of the top five producers of pentoxide products and potassium heptafluorotantalate in terms of production volume in China in 2018:

Ranking	Enterprises	Background	Location	Registered share capital RMB in million	Production volume tonnes	Production volume for external sales tonnes	Utilisation rate of production facility (by production volume) %	Market share (by production volume for external sales) %
1	Our Group	A private enterprise that specialises in offering tantalum- and niobium-based metallurgical products	Guangdong Province	33.8	1,321.0	1,321.0	88.7%	35.8%
2	Company One	A private enterprise that specialises in offering tantalum- and niobium-based metallurgical products	Jiangxi Province	30.0	545.0	545.0	66.5%	14.8%
3	Company Two	A private enterprise that specialises in offering tantalum- and niobium-based metallurgical products	Hunan Province	15.8	460.0	460.0	29.7%	12.5%
4	Company Three	A state-owned enterprise that provides a comprehensive set of tantalum and niobium products	Jiangxi Province	133.6	570.0	403.0	74.0%	10.9%
5	Company Four	A private enterprise that specialises in offering niobium-based metallurgical products	Jiangsu Province	30.0	330.0	330.0	66.0%	8.9%

Source: China Tantalum and Niobium Association, CIC

We achieved a higher utilisation rate of production facilities compared with other key competitors in 2018 mainly because of: (i) our continuous efforts in upgrading and optimising our production process and technologies to enhance our production efficiency and lower our costs; and (ii) significant increase in our sales volume for the same period attributable to our products consistently meeting the industry standards on purity and enhanced brand recognition. According to CIC, the utilisation rate of the major players in the PRC tantalum and niobium hydrometallurgy industry is an indicator of a company's competitiveness.

Driven by the favourable PRC government policies and development of downstream industries, our Group recorded rapid growth in terms of production volume from 2016 to 2018, with a CAGR of 22.6%. Between 2016 and 2018, market size for China's tantalum- and niobium-based hydrometallurgical products in terms of production volume for external sales grew from 2,924.9 tonnes to 3,690.0 tonnes, representing a CAGR of 12.3%. The higher growth of production volume of our Group than that of the overall market indicates that our Group has acquired a larger share of the market.

INDUSTRY OVERVIEW

We own the largest number of patents among the major players in the tantalum- and niobium-based hydrometallurgical products companies in China. The table below sets forth the comparison of the number of patents owned by us with that of patents owned by other major market players:

	Number of utility patents		Number of invention patents (Note)		Total
	Under review	Valid	Under review	Valid	
Our Group	1	19	10	5	35
Company One	0	0	0	0	0
Company Two	0	5	0	0	5
Company Three	0	6	6	9	21
Company Four	0	0	0	0	0

Note: The number of patents only includes self-developed patents.

Source: search.cnipr.com

The table below sets forth the number of patents owned by us by function:

Function	Number of patents
Increasing the purity of our products	6
Increasing our production efficiency and the output yields of our products	6
Enhancing our capability to meet environmental protection requirements	9

The table below sets forth the comparison of the output yields of our products compared with the industry norm:

	Overall Output Yield			
	Our Group (2016)	Our Group (2017)	Our Group (2018)	Industry norm
Industrial grade tantalum pentoxide	92.3%	92.5%	93.2%	90%–92%
High-purity tantalum pentoxide	86.8%	91.7%	91.7%	86%–88%
Industrial grade niobium pentoxide	95.9%	96.6%	96.6%	93%–94%
High-purity niobium pentoxide	93.5%	95.4%	95.0%	89%–90%
Potassium heptafluorotantalate	93.1%	92.4%	93.2%	90%–92%

Source: CIC

Our patented technologies are recognised in the industry in China because: (i) we were able to achieve higher output yields of our products compared with industry participants using standard production techniques, as estimated by CIC, which could be attributed to six of our patents utilised to increase our production efficiency and output yields; (ii) we have complied with the pollutant emission limits each year within the valid period of the relevant pollutant emission permits during the Track Record Period, which could be attributed to nine of our patents, which were utilised to deal with waste gas and waste water, and reduce noise; and (iii) the highest purity of our high-purity pentoxide products delivered to our clients was not less than 99.99%, compared with the industry standards for high-purity pentoxide products on purity level of not less than 99.95%, which could be attributable to six of our patents utilised to increase the purity of our products. For FY2016, FY2017 and FY2018, 91.7%, 94.6% and 100.0% of our sales volume of high-purity pentoxide products, respectively, had a purity level of not less than 99.99% although some of the sales contracts only required purity level of not less than 99.95% (according to CIC, approximately 40% of the sales contracts for high-purity tantalum pentoxide and niobium pentoxide in the PRC market require a purity level of not less than 99.99%).

Producing tantalum pentoxide and niobium pentoxide at a purity level of not less than 99.99% requires special impurity-removing techniques, and therefore, only a limited number of the manufacturers of tantalum- and niobium-based hydrometallurgical products in the PRC have capacity to produce such products. As at 31 December 2018, only three of the top five players and another state-owned enterprise were able to produce tantalum pentoxide and niobium pentoxide at a purity level of not less than 99.99%. In 2018, we had the highest percentage of high-purity pentoxide products produced with a purity level of not less than 99.99%.

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The table below sets forth the comparison of the percentage of high-purity pentoxide products produced with a purity level of not less than 99.99% among the top five players in the industry in 2018:

	Percentage of high-purity pentoxide products produced with a purity level not less than 99.99%	
	Tantalum pentoxide	Niobium pentoxide
Our Group	100.0%	100.0%
Company One	45.0%	35.0%
Company Two	0%	0%
Company Three	71.0%	65.0%
Company Four	0%	0%

Source: CIC

For manufacturers of tantalum- and niobium-based hydrometallurgical products in the PRC, compliance with the PRC environmental protection requirements plays a vital role in maintaining competitiveness in the industry. The lack of capacity in dealing with waste gas and other types of waste may result in regulatory non-compliance, which will lead to suspension of operation, revocation of production certificate, and potential fines. During the Track Record Period, according to records available in the public domain, there were seven punishment records committed by four of the manufacturers of tantalum- and niobium-based hydrometallurgical products in the PRC due to non-compliance with environmental protection requirements. Some of them have been required to suspend production for as long as six months, which could have negative impacts on their production volume and market shares in the relevant year. We have not been fined by the relevant authorities for violation of PRC laws and regulations related to environmental protection during the Track Record Period.

Meanwhile, the production capacity of the manufacturers of tantalum- and niobium-based hydrometallurgical products in the PRC is also affected by their waste disposal capacity because they are required to comply with the pollutant emission limits within the valid period of the relevant pollutant emission permits. For FY2016 and FY2017, we ranked first in terms of production capacity partly due to our waste disposal technology and capacity, which enabled us to have a relatively high level of production capacity while at the same time comply with environmental protection requirements including the pollutant emission limits. The table below sets forth the production capacity of the top five players for FY2016, FY2017 and FY2018:

	FY2016	FY2017	FY2018
	tonne	tonne	tonne
Our Group	1,011	1,011	1,489.5
Company One	495	640	820
Company Two	700	700	1,550
Company Three	570	770	770
Company Four	500	500	500

Source: CIC

Growth Drivers

We believe the following factors will drive the growth of the PRC market for pentoxide products and potassium heptafluorotantalate:

- *Growing demand from various downstream industries.* Given the favourable properties of tantalum and niobium metal such as high melting point, corrosion-resistance, and superconductivity, tantalum- and niobium-based metallurgical products are essential in the downstream manufacture of various products used in high-tech industries, including special alloys, chemical, electronic ceramics, aeronautics, aerospace, high-end electronics, defence and hard alloy. As market size for hard alloy, aviation equipment manufacturing, erosion-resistant equipment industry in China is expected to grow at CAGRs of 8.6%, 28.6%, and 9.8%, respectively, between 2018 and 2023, the demand for tantalum- and niobium-based metallurgical products is anticipated to grow accordingly.
- *Technology upgrade.* New advances in tantalum- and niobium-based hydrometallurgical products manufacturing technologies have driven and will continue to drive the development of high-purity tantalum- and niobium-based hydrometallurgical products, while at the same time reduce production costs.

INDUSTRY OVERVIEW

- Strengthening stability in raw materials supplies.** As tantalum ores and niobium ores are the key raw materials required for the manufacturing of tantalum- and niobium-based hydrometallurgical products and over 85% of the tantalum ores and niobium ores consumed by PRC enterprises are imported from overseas, access to and stable supply of tantalum ores and niobium ores are critical to the timely delivery of products and the expansion of production capacity for enterprises in the PRC tantalum and niobium metallurgy industry. To ensure the stable supply of raw materials, the PRC Government and the manufacturers of tantalum- and niobium-based hydrometallurgical products in the PRC have built good cooperative relationships with, and seek opportunities to invest in, suppliers of tantalum ores and niobium ores, which in turn will drive the growth of the PRC tantalum and niobium metallurgy industry.

THE PRC TANTALUM- AND NIOBIUM-BASED PYRO-METALLURGICAL PRODUCTS MARKET

Market Size and Forecast

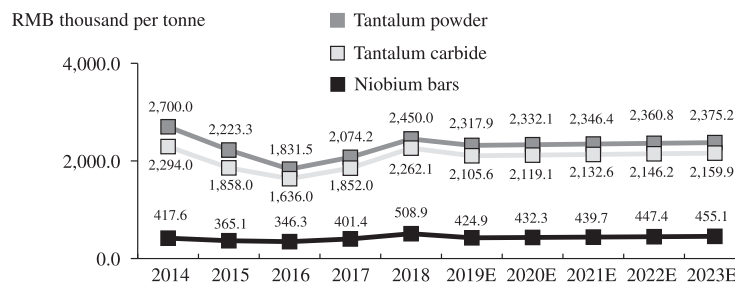
The tantalum- and niobium-based pyro-metallurgical products mainly include tantalum powder, tantalum carbide and niobium bars. The production volume of tantalum- and niobium-based pyro-metallurgical products in China increased from 572.1 tonnes in 2014 to 942.9 tonnes in 2018, representing a CAGR of 13.3%, and is expected to further increase to 1,279.0 tonnes in 2023, representing a CAGR of 6.3%.

Average Selling Price

The average selling price for tantalum powder in China decreased from RMB2.7 million per tonne in 2014 to RMB1.8 million per tonne in 2016 and increased to RMB2.5 million per tonne in 2018. The average selling price for tantalum carbide in China decreased from RMB2.3 million per tonne in 2014 to RMB1.6 million per tonne in 2016, followed by an increase to RMB2.3 million per tonne in 2018. The average selling price for niobium bars in China decreased from RMB417,600 per tonne in 2014 to RMB346,300 per tonne in 2016, and increased to RMB508,900 per tonne in 2018. Between 2014 and 2016, the downward price trend of these tantalum- and niobium-based pyro-metallurgical products was mainly due to: (i) the decreased average market prices for imported tantalum ores and niobium ores for the same period; and (ii) the relatively weak bargaining power of the PRC-based manufacturers of tantalum and niobium metallurgical products, who were still in the process of building up their customer base. From 2016 to 2018, the upward trend of the prices was in line with the price increase in tantalum ores and niobium ores from 2016 to 2018.

The average selling price for tantalum powder in China is expected to reach RMB2.4 million per tonne in 2023. The average selling price for tantalum carbide in China is expected to reach RMB2.2 million per tonne in 2023. The average selling price for niobium bars in China is expected to reach RMB455,100 per tonne in 2023. The expected decline in 2019 was mainly because the prices in 2018 have reached a peak in the short term. The expected upward price trend of these tantalum- and niobium-based pyro-metallurgical products is mainly based on: (i) an expected recovery in demand for tantalum- and niobium-based pyro-metallurgical products; and (ii) an expected increasing bargaining power of the PRC-based manufacturers of tantalum and niobium metallurgical products in line with their broadening customer base.

PRC annual average market price for tantalum powder, tantalum carbide and niobium bars (2014–2023E)



Source: China Tantalum and Niobium Association, CIC

INDUSTRY OVERVIEW

Growth Drivers

The tantalum- and niobium-based pyro-metallurgical products are used in a variety of downstream industries, including, among others, the high-end electronic ceramics, super alloys, defence and hard alloy industries. Such downstream industries are expected to experience rapid development in the coming years, which in turn will drive the demand for tantalum- and niobium-based pyro-metallurgical products in China.

Production capacity of key market players of tantalum powder

Our Group's expansion plan includes the extension of its production to tantalum powder. The production volume of tantalum powder in the PRC was 485.5 tonnes in 2018 and the total production capacity of the key manufacturers of tantalum powder was approximately 610 tonnes in the same year. Sufficient production capacity does not necessarily block out new entrants in this market due to fact that customers of tantalum- and niobium-based pyro-metallurgical products do not choose suppliers based on the production capacity but rather the quality of products and the capacity of the suppliers to meet their specific requirements.

Between 2018 and 2023, the production volume of tantalum powder in the PRC is expected to grow from 485.5 tonnes in 2018 to 609.1 tonnes in 2023, representing a CAGR of 4.6%. During the same period, two of the key market players are expected to expand their production capacity and one of the market players is expected to reduce its production due to a shift in development strategy. There is no public information on whether the remaining two key players will expand or reduce their production capacity.

The table below sets out the effective production capacity of key manufacturers of tantalum powder as of 30 June 2019.

<u>Company name of key market players</u>	<u>Effective production capacity of tantalum powder (tonnes)</u>
Company Five	300
Company Six	150
Company Seven	70
Company Eight	60
Company Three	30

There is still room for expansion of the production capacity of tantalum powder because: 1) utilisation rate of the production capacity of tantalum powder in the PRC was approximately 80% in 2018, which fell within the reasonable range of that of the manufacturing industry in the PRC. According to the CIC Report, it is common that production utilisation rate of the manufacturing industry to fall within the range between 60% and 80% as time is needed for the maintenance and repair to ensure sustainable production as well as technology upgrade, production lines update and adjusting and testing of the equipment to ensure their products would meet the requirement of the customers, and there would be mismatch in time between availability of production capacity of the manufacturers and customers' orders; 2) between 2014 and 2018, new production capacity was added and the size of the market grew, indicating healthy development of this industry. The production volume of tantalum powder grew from 327.0 tonnes in 2014 to 485.5 tonnes in 2018. During the same period, one of the key market players expanded its production capacity and a market player entered this market by establishing new production facilities, indicating strong willingness in investing in this industry; and 3) production volume of tantalum powder in the PRC is expected to grow from 485.5 tonnes in 2018 to 609.1 tonnes in 2023, representing a CAGR of 4.6%. In order to fulfil the production volume of tantalum powder within the next five years, investment in the production capacity of tantalum powder is required in advance to accommodate future growth in the production volume of tantalum powder.

THE PRC TANTALUM- AND NIOBIUM-BASED PROCESSED PRODUCTS MARKET

Market Size and Forecast

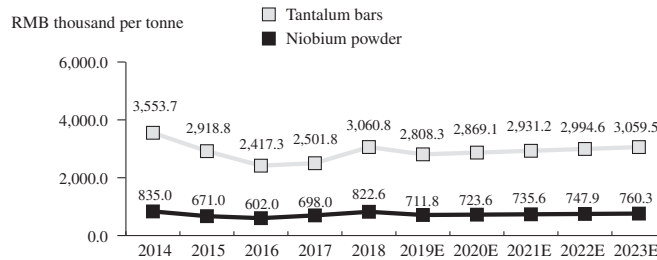
The production volume of tantalum bars in China increased from 146.0 tonnes in 2014 to 221.6 tonnes in 2018, representing a CAGR of 11.0%, and is expected to further increase to 337.6 tonnes in 2023, representing a CAGR of 8.8%. The production volume of niobium powder in China increased from 16.0 tonnes in 2014 and 22.7 tonnes in 2018, representing a CAGR of 9.1%, and is expected to increase to 31.1 tonnes in 2023, representing a CAGR of 6.5%.

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Average Selling Price and Forecast

The average selling price for tantalum bars in China decreased from RMB3.6 million per tonne in 2014 to RMB2.4 million per tonne in 2016, and increased to RMB3.1 million per tonne in 2018. The average selling price for niobium powder in China decreased from RMB0.8 million per tonne in 2014 to RMB0.6 million per tonne in 2016, and increased to RMB0.8 million per tonne in 2018. The downward trend at the beginning was mainly because the PRC-based manufacturers of such products were in the process of building up their customer base, which in turn resulted in their relatively weak bargaining power. The following increase was mainly due to the increase of the prices of the raw materials. According to CIC, the average selling prices for tantalum bars and niobium powder in China are expected to decline slightly in 2019 and rebound in the near future based on the assumptions as follow: (i) an expected recovery in demand for tantalum- and niobium-based processed products; (ii) an expected increasing bargaining power of the PRC-based manufacturers of tantalum- and niobium-based processed products in line with their broadening customer base; and (iii) an expected wider market recognition of the PRC-based manufacturers given their continuous efforts in research and development. The following graph illustrates the average selling prices for tantalum bars and niobium powder in China for the periods indicated:

PRC annual average market prices for tantalum bars and niobium powder (2014–2023E)



Source: China Tantalum and Niobium Association, CIC

Growth Drivers

Tantalum bars and niobium powder are widely used in the production of heat-resistant special alloys in the aerospace industry, and mill products that can be applied in chemical equipment industries, semi-conductor industries, etc.. Such downstream industries are expected to experience rapid development in the coming years, which in turn will drive the demand for tantalum- and niobium-based processed product in China.

Production capacity of key market players

The table below sets out the production capacity of key manufacturers of tantalum bars as of 30 June 2019. Between 2018 and 2023, the production volume of tantalum bars is estimated to grow at a CAGR of 8.8% and is expected to exceed current total production capacity of key players, which leaves room for the expansion of production capacity of market players within the next five years. During the same period, one of the key market players is expected to expand its production capacity and one of the key market players is expected to reduce its production capacity due to a shift in the company's strategy. There is no public information on whether the remaining three key players will expand or reduce their production capacity.

Company name of key market players	Production capacity of tantalum bars (tonnes)
Company Five	200
Company Seven	20
Company Six	60
Company Ten	20
Company Eight	25

There is still room for expansion of the production capacity of tantalum bars because: 1) utilisation rate of the production capacity of tantalum bars in the PRC was approximately 68.2% in 2018, which fell within the reasonable range of that of the manufacturing industry in the PRC. According to the CIC Report, it is common that production utilisation rate of the manufacturing industry to fall within the

INDUSTRY OVERVIEW

range between 60% and 80% as time is needed for the maintenance and repair to ensure sustainable production as well as technology upgrade, production lines update and adjusting and testing of the equipment to ensure their products would meet the requirement of the customers, and there would be mismatch in time between availability of production capacity of the manufacturers and customers' orders; 2) between 2014 and 2018, new production capacity was added and the size of the market grew, indicating healthy development of this industry. The production volume of tantalum bars grew from 146.0 tonnes in 2014 to 221.6 tonnes in 2018. During the same period, three of the key market players expanded their production capacity, indicating their confidence in investing in this industry; and 3) production volume of tantalum bars in the PRC is expected to grow from 221.6 tonnes in 2018 to 337.6 tonnes in 2023, representing a CAGR of 8.8%. In order to fulfil the production volume of tantalum bars within the next five years, investment in the production capacity of tantalum bars is required in advance to accommodate future growth in the production volume of tantalum bars.

EXPECTED GROWTH AND POTENTIAL IMPACTS OF THE SINO-US TRADE CONFLICTS ON THE DOWNSTREAM INDUSTRIES OF TANTALUM- AND NIOBIUM-BASED HYDROMETALLURGICAL AND PYRO-METALLURGICAL PRODUCTS AND TANTALUM BARS

With high thermal and electrical conductivity, high melting point, as well as corrosion-resistance nature, tantalum- and niobium-based pyro-metallurgical products and tantalum bars are ultimately used in various applications such as electronic equipment, medical devices, parts used in aerospace, chemical equipment, semi-conductors, etc.. Since all tantalum- and niobium-based pyro-metallurgical products are produced from tantalum- and niobium-based hydrometallurgical products, downstream products of pyro-metallurgical products are also downstream products of hydrometallurgical products. Downstream applications of tantalum- and niobium-based pyro-metallurgical products and tantalum bars are expected to see strong growth, with the market size of MRI devices, semi-conductor, erosion-resistant equipment, and aviation equipment expected to grow at CAGRs of 3.6%, 5.5%, 9.8% and 28.6%, respectively, between 2018 and 2023.

The recent Sino-US trade conflicts have led to additional tariff imposed by the U.S. on several batches of products exported to the U.S.. Since most of the tantalum- and niobium-based pyro-metallurgical products and tantalum bars are processed to direct downstream products such as tantalum capacitor and tantalum- and niobium-based metal materials in China and then exported to other countries to be further processed and applied in the abovementioned industries, only direct downstream products that are exported to the U.S. are subject to Sino-US trade conflicts. A number of downstream products of tantalum powder, tantalum carbides, niobium bars and niobium carbides will be charged for 25% additional tariff, namely tantalum capacitors, tantalum/niobium sputtering target, niobium titanium alloy rod, and tantalum-/niobium- containing knives and cutting blades. An increase in tariff imposed will hinder the demand from U.S. companies for the relevant downstream products. Given (1) not more than 50% of the total production volume of the direct downstream products of tantalum- and niobium-based pyro-metallurgical products and tantalum bars produced in the PRC was exported, (2) the U.S. is usually not the top exporting countries of direct downstream products of tantalum- and niobium-based pyro-metallurgical products and tantalum bars and (3) the percentage of export value to the U.S. to export value to top 10 countries of direct downstream products of tantalum- and niobium-based pyro-metallurgical products and tantalum bars ranges from approximately 6% to approximately 23%, which is much less than that of the European Countries or other top 10 countries (including the Asia Pacific, South America and the Middle East), only around 10% of such downstream products produced in the PRC was exported to the U.S.. Given the fact that most of these downstream products are not mainly exported to the U.S., the impact of Sino-US trade conflicts is relatively limited.

INDUSTRY OVERVIEW

The table below sets forth the direct downstream products of tantalum- and niobium-based pyro-metallurgical products and tantalum bars, additional tariff imposed by the U.S. on the relevant downstream products, and the degree of dependence on the U.S. as an exporting country for relevant downstream products.

Downstream product	Relevant tantalum- and niobium-based pyro-metallurgical products and processed products as raw materials	HS code for global trade	Headings for the HS code	Additional tariff imposed by the U.S.	Export value to the U.S./Export value to top 10 countries
Tantalum capacitor	Capacitor-grade tantalum powder	85322100	Tantalum fixed capacitors (鉭電容器)	25%	21.5%
Tantalum sputtering target	Metallurgical grade tantalum powder	8486909100	Sputtering target assembly with rear panel (帶背板的濺射靶材組件)	25%	6.1%
		8103909090	Other wrought tantalum and articles thereof (其他鍛軋鉭及其製品)	N	—
High-purity tantalum wires	Metallurgical grade tantalum powder	8103901100	Wire of tantalum, less than 0.5mm in diameter (直徑小於0.5mm的鉭絲)	N	—
		8103901900	Other wire of tantalum (其他鉭絲)	N	—
Niobium sputtering target	Niobium bars	8112994000	Wrought niobium and articles thereof (鍛軋的鈮及其製品)	25%	19.5%
Niobium titanium alloy rod	Niobium bars	8112994000	Wrought niobium and articles thereof (鍛軋的鈮及其製品)	25%	19.5%
Tantalum-/niobium-containing knives and cutting blades	Tantalum/niobium carbides	8208101100	Knives and cutting blades, for machines or for mechanical appliances, plated or coated, of metal carbides (經鍍或塗層的硬質合金制的金工機械用刀及刀片(金屬加工用))	25%	23.2%
		8208101900	Other knives and cutting blades, for machines or for mechanical appliances, of metal carbides (其他硬質合金制的金工機械用刀及刀片(金屬加工用))	25%	14.2%
Mill products of tantalum	Tantalum bars	8103909090	Other wrought tantalum and articles thereof (其他鍛軋鉭及其製品)	N	—

Note 1: “N” means no additional tariff imposed by the U.S. in the Sino-US trade conflicts as of 30 November 2019.

Note 2: Export value to the U.S./Export value to top 10 countries was based on 2018. Figures were based on HS code 85322110, 84869091, 82081011, and 82081019, respectively.

Note 3: Two types of tantalum capacitors are free from the additional tariff imposed on products under HS code 85322100 including: (1) tantalum capacitors having a conductive polymer cathode that are valued not over US\$4 per unit and; (2) tantalum capacitors, each measuring 7.3 mm by 4.3 mm by 1.9 mm and valued not over US\$4.

INDUSTRY OVERVIEW

POTENTIAL IMPACTS OF THE SINO-US TRADE CONFLICTS ON TANTALUM- AND NIOBIUM-BASED HYDROMETALLURGICAL PRODUCTS, PYRO-METALLURGICAL PRODUCTS, AND TANTALUM BARS

The table below demonstrates additional tariff imposed by the U.S. on tantalum- and niobium-based hydrometallurgical products, pyro-metallurgical products, and tantalum bars imported from China and the degree of dependence on the U.S. as an exporting country for the relevant products.

Tantalum pentoxide, niobium pentoxide, tantalum carbides, niobium bars and niobium powder are impacted by additional tariff imposed by the U.S. in the Sino-US trade conflicts. Since the export volume of these products to the U.S. did not constitute a material portion of total production volume for external sales in China in 2018, Sino-US trade conflicts have relatively limited influence on other tantalum- and niobium-based hydrometallurgical products, pyro-metallurgical products, and tantalum bars in China.

<u>Relevant tantalum- and niobium-based products</u>	<u>HS code for global trade</u>	<u>Headings for the HS code</u>	<u>Additional tariff imposed by the U.S.</u>	<u>Export volume to the U.S./total production volume for external sales in China</u>
Tantalum pentoxide and niobium pentoxide	2825.90.90	Other inorganic bases; other metal oxides, hydroxides and peroxides, nesoi	25%	5.0%
Potassium heptafluorotantalate	2826.90.90	Other complex fluorine salts, nesoi	N	—
Tantalum carbides	2849.90.90	Carbides, nesoi	25%	10.0%
Tantalum powder	8103.20.11	Tantalum powder, loose density less than 2.2 gram per cubic centimetre	N	—
Tantalum powder	8103.20.19	Other powders of tantalum	N	—
Niobium bars and niobium powder	8112.92.40	Unwrought niobium and its powders, and unwrought niobium waste and scrap	25%	6.6%
Tantalum bars	8103.90.90	Other wrought tantalum and articles thereof, and tantalum crucible with tantalum ingot, bars, plate and other wrought products included	N	—

Source: CIC

Note: "N" means no additional tariff imposed by the U.S. in the Sino-US trade conflicts as of 30 November 2019.