Brief Introduction to the Development of Mg, Al and Ti Industry in China

中国镁铝钛产业发展概况简介

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中国有色金属工业协会

The Nonferrous Metals Society of China

中国有色金属学会

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Outline（提纲）

- **Overview of the basic situation in China**

  中国的基本情况概述
- **Development of magnesium industry in China**

  中国镁产业发展概况
- **Development of aluminum industry in China**

  中国铝产业发展概况
- **Development of titanium industry in China**

  中国钛产业发展概况
- **Key direction of the " 13th Five-Year Plan"**

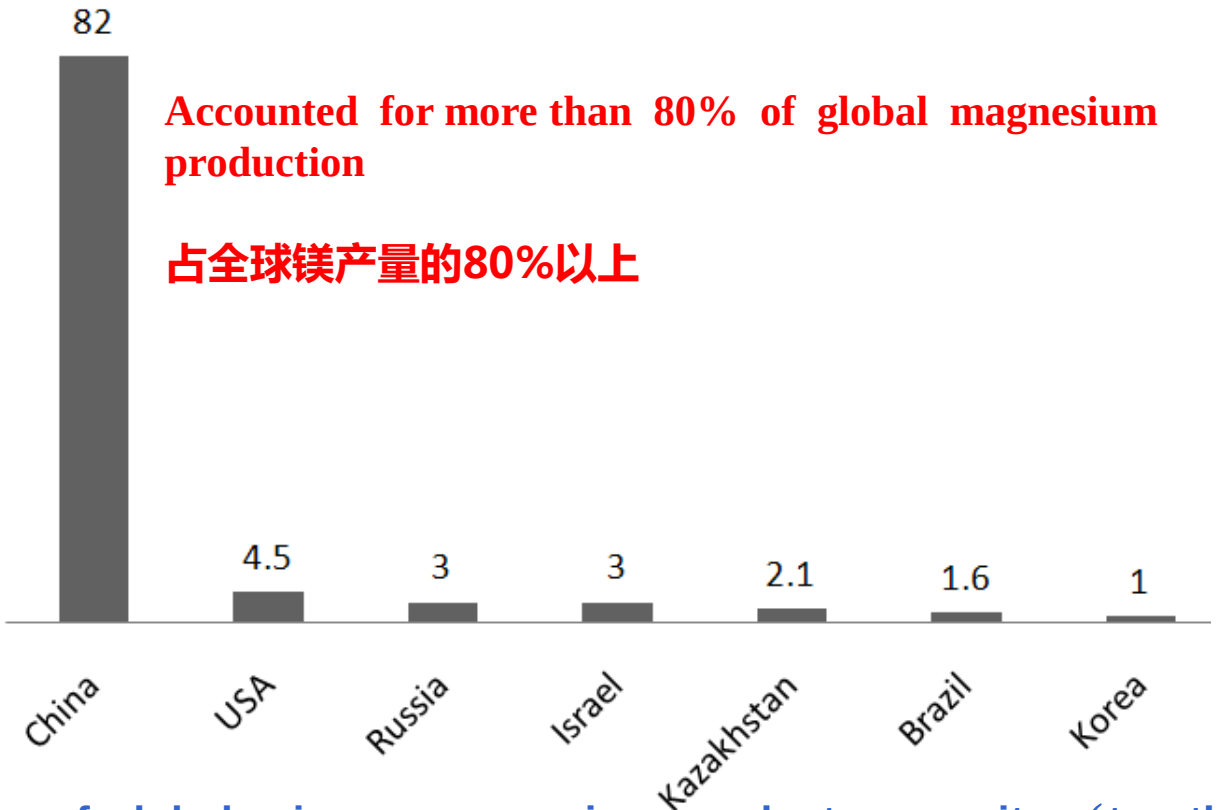
  “十三五”重点方向

Overview of the basic situation in China

中国基本情况的概述

Overview of the basic situation in China

Chinese primary magnesium products capacity ranks first in the world
中国的主要镁生产能力居世界第一位



Accounted for more than 80% of global magnesium production

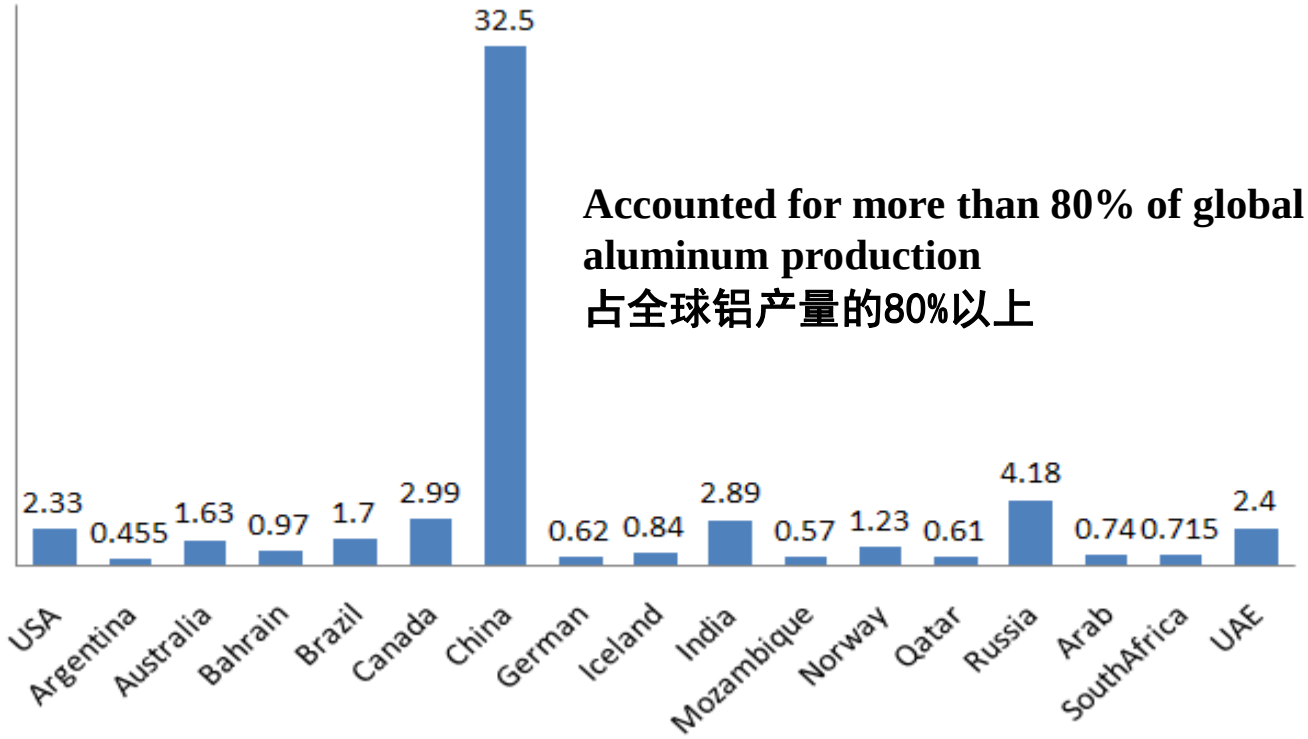
占全球镁产量的80%以上

Comparison of global primary magnesium products capacity （ten thousand tons）in 2015

2015年主要镁生产国产量（万吨）对比

Overview of the basic situation in China

Chinese primary aluminum products capacity ranks first place in the world
中国铝生产能力居世界第一位



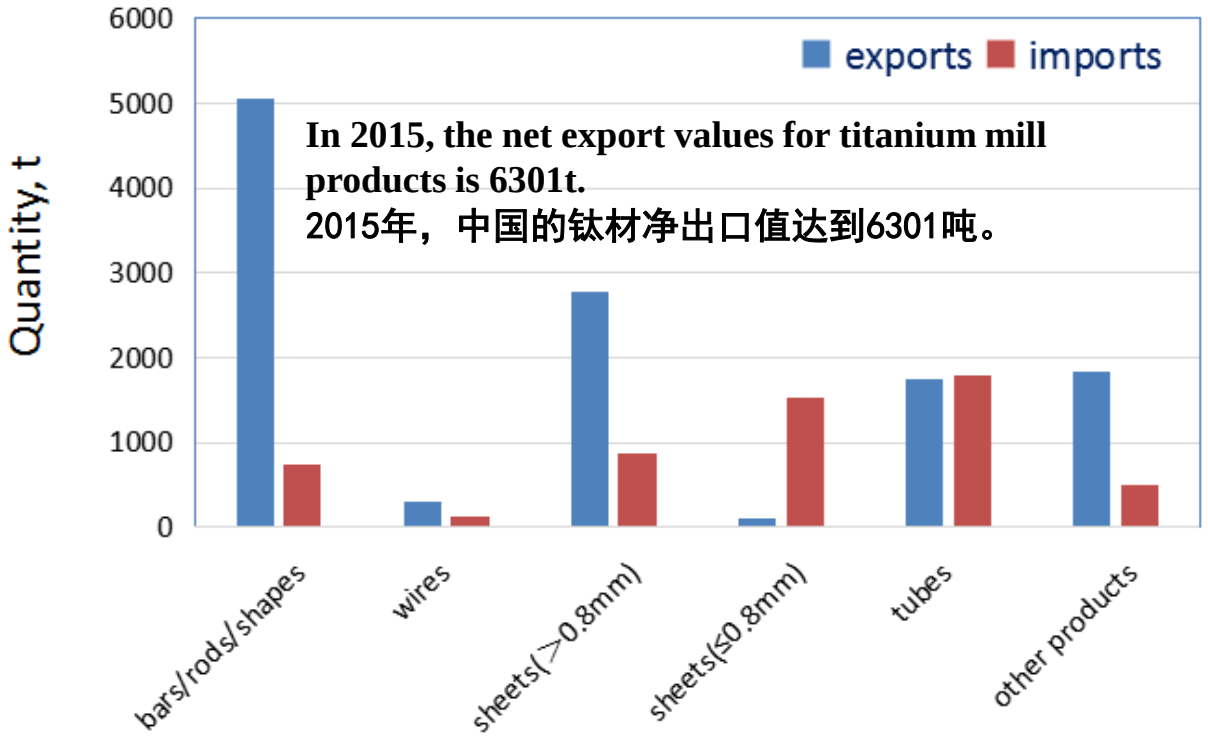
Compared with the global primary aluminum products capacity （ Million tons） in 2015

2015年全球主要国家铝产量（百万吨）对比

Overview of the basic situation in China

At present, there are only 4 countries have complete Ti industry chins from mineral to the end products, those countries are United States, Japan, Russia and China.

目前，世界上拥有从矿石到钛材生产完整钛工业的国家仅美国、日本、俄罗斯和中国



Exports and imports of China titanium products in 2015

2015年中国钛产品进出口情况

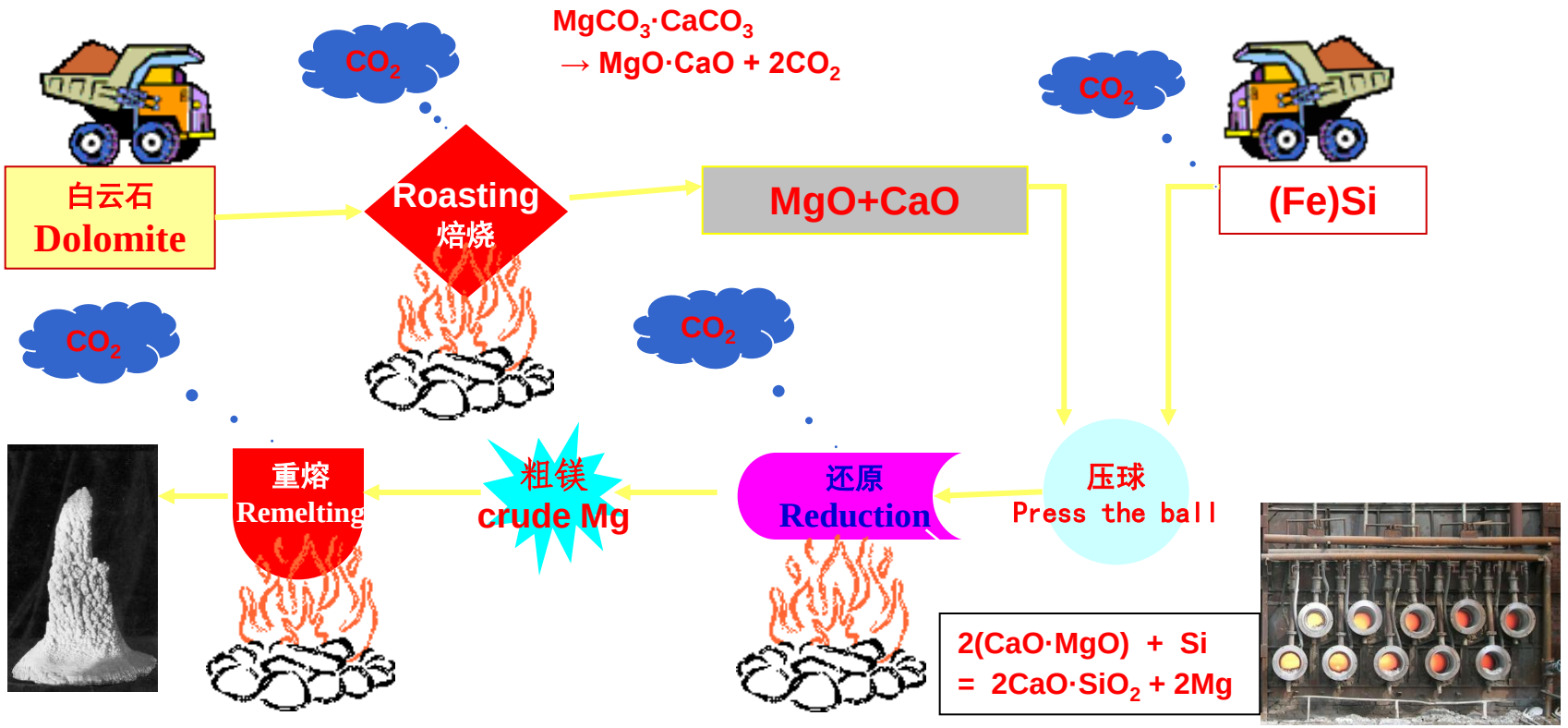
Development of Magnesium Industry in China

中国镁工业发展概况

Development of Magnesium industry in China

For a long time, the energy consumption and environmental pollution in the magnesium smelting process have been the biggest issues in the development of the magnesium industry in China.

长期以来，镁冶炼过程中的能源消耗和环境污染一直是我国镁工业发展中的最大问题

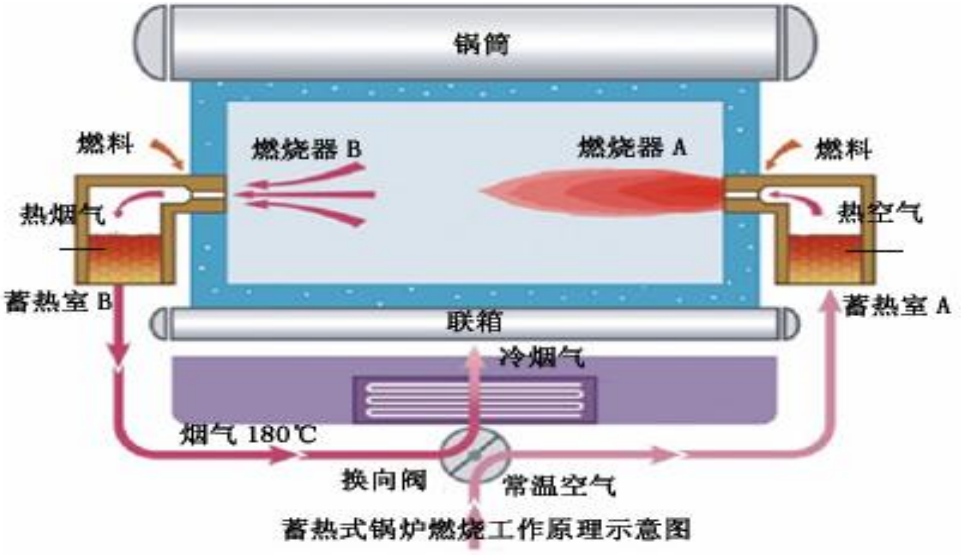


Development of Magnesium industry in China

The new smelting technology in magnesium 新型镁冶炼技术

- ✓ Two new smelting technology has been widely used in magnesium smelting:
- ✓ The reducing furnace of vertical tank and bottom slag technology has been widely used in magnesium smelting. **立式罐和底除渣还原炉已应用于生产**
- ✓ The regenerative combustion technology, with other waste heat recycle technology have also been used in the magnesium smelting. **蓄热燃烧及余热回收技术也应用于镁冶炼**

Standard coal consumption /1 tons of magnesium less than 4.5 tons.标准煤消耗/1吨镁＜4.5吨



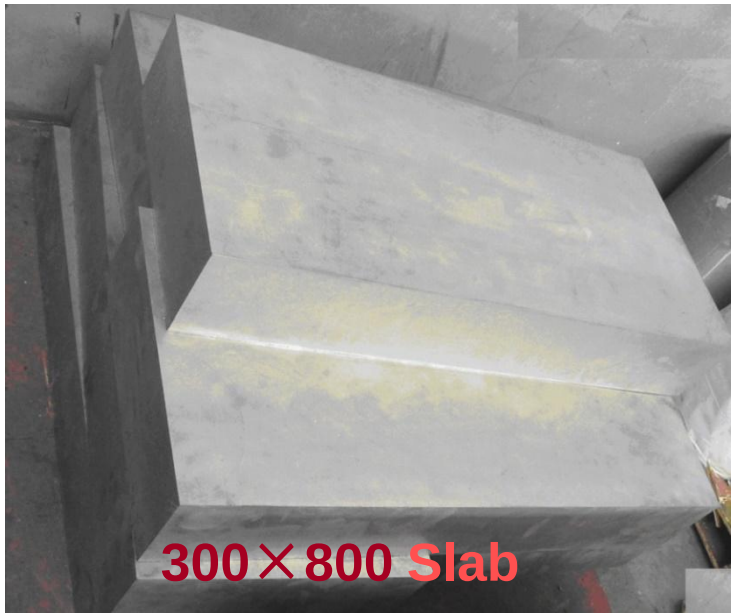
蓄热式锅炉燃烧工作原理示意图

Development of Magnesium industry in China

Semi-continuous electromagnetic casting technology 半连续电磁铸造技术

With the semi-continuous electromagnetic casting technology ,the large size of round billet and slab with fine grain size have been developed, with the sizes of 100-800mm in diameter and 300 x 800mm square mm.

通过改进电磁铸造工艺，开发出表面光滑、晶粒细小的镁合金连铸圆坯和板坯，最大规格分别达到直径800mm和300*800mm

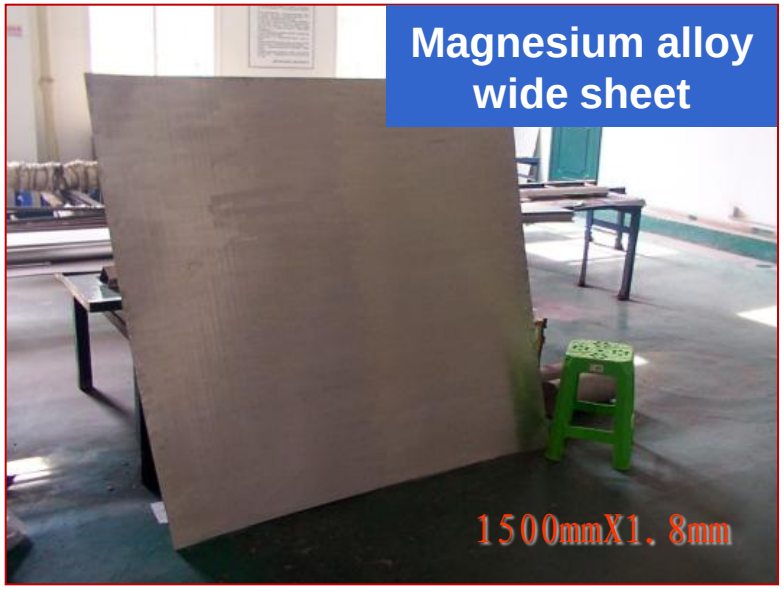


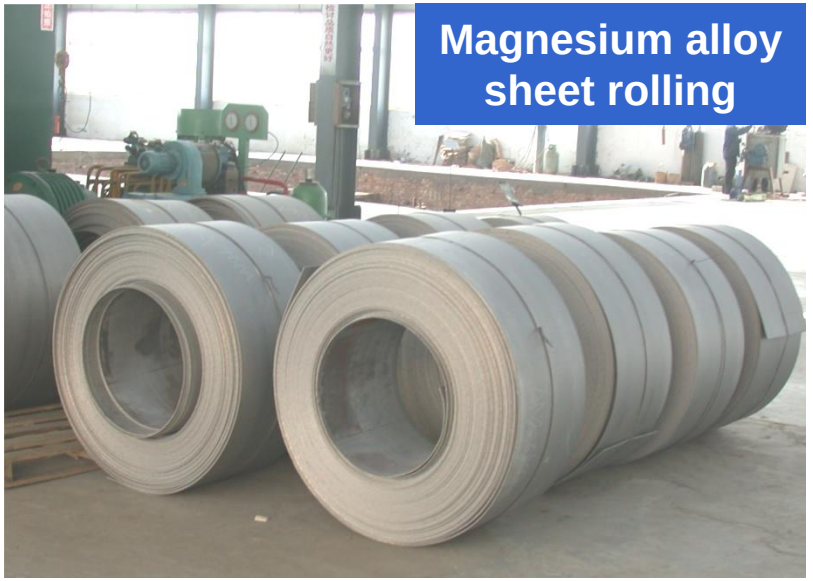
Development of Magnesium industry in China

Low cost sheet and forming technology 低成本板材成形技术

Based on the high quality magnesium alloy ingot, the 1500mm width and 1.8mm thick magnesium alloy sheet has been successfully developed by using the optimized sheet cold rolling and annealing process, as well as the key technologies of the roll edge crack control technology

基于高质量镁合金大锭坯，通过优化冷却和退火工艺及卷边裂纹控制等关键技术，开发出1500mm宽,1.8mm厚的镁合金薄板





Development of magnesium industry in China

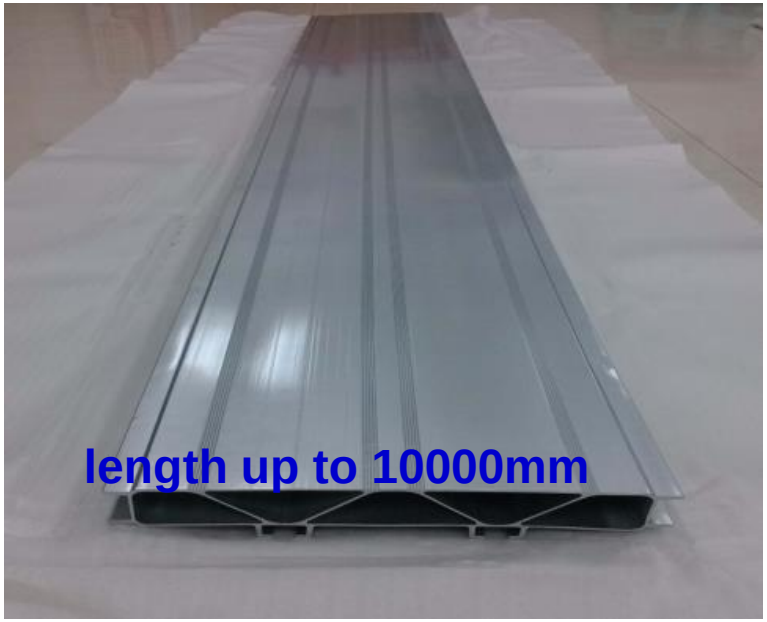
Low cost extrusion and forming technology 低成本挤压成形技术

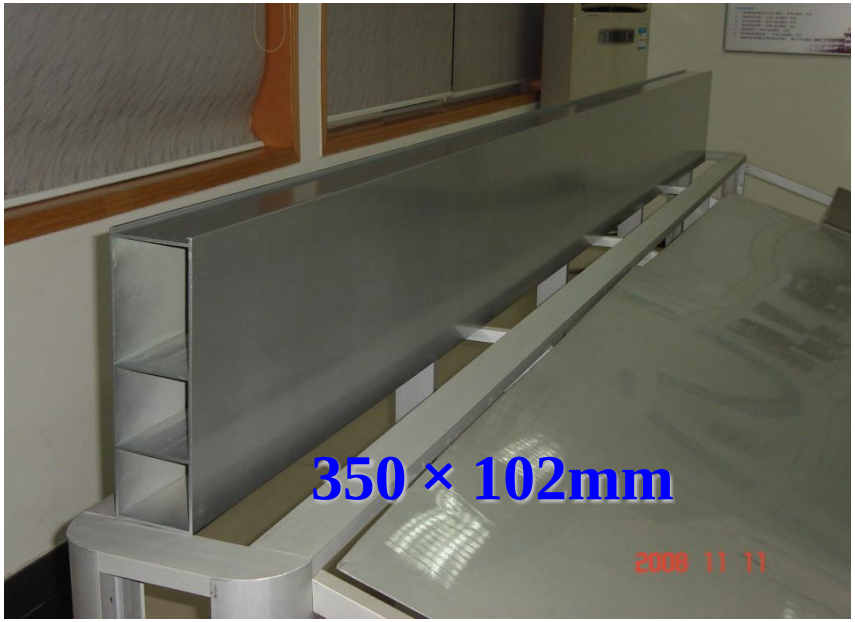
Developed the world largest hollow and thin wall special magnesium alloy profiles have been developed…

(width 424mm, high 60mm, wall thickness 2-5mm, length up to 10000mm).

开发出最大空心薄壁镁合金型材

（截面宽度424mm，高60mm，壁厚5mm，长度可达10000mm）

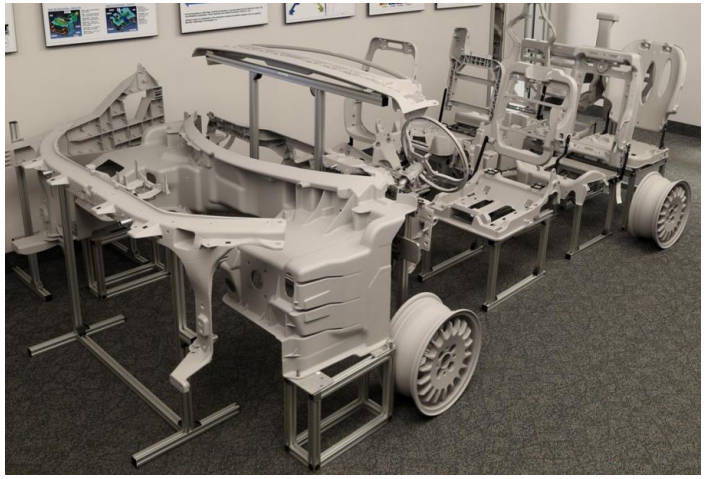




Development of magnesium industry in China

Development of Mg die casting enterprises in China 镁压铸企业发展

- **Magnesium die casting industry in China has been developed rapidly, especially at the end of 2013, Wan Feng Auto Group acquired the world largest magnesium die casting industry**
- **At this point, China's magnesium alloy automobile die casting production has been ranked first in the world, accounting for more than 60% of the North American market**
- **中国镁压铸产业发展迅速，特别是2013年底，万丰奥特集团收购了全球最大的镁压铸**企业。至此，中国镁合金汽车压铸件产量已位居世界第一，占北美市场的**60%**以上



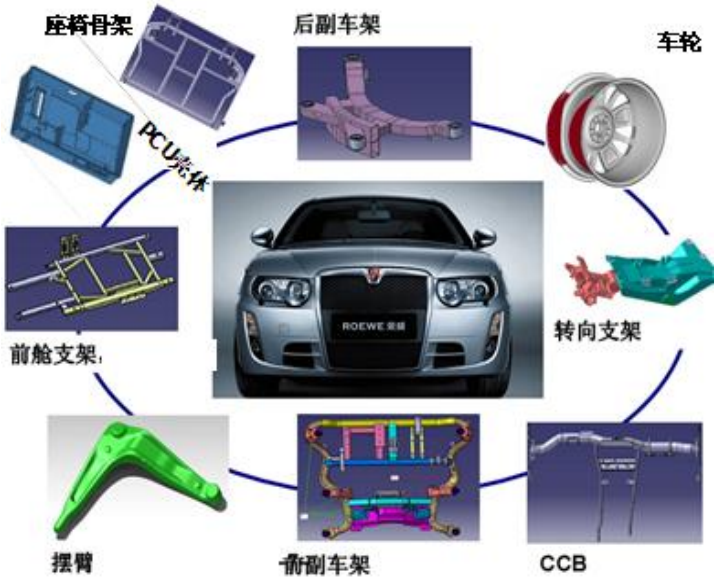
Development of magnesium industry in China

Application 应用情况

China has always pay attention to the magnesium alloys application in the automobile industry. the instrument panel, front and rear subframe, wheels, steering bracket and other parts have been developed in the platform of a independent research and developed hydrogen fuel car. The total amount of magnesium alloy used in one car is more than 100 kilograms.

我国一直重视镁合金在汽车上的示范应用，针对自主研发的一款氢燃料轿车，研制出仪表板、前后副车架、轮毂、转向支架等零件，镁合金在一台车上的用量达到100公斤以上

The fuel economy and dynamic performance test of real photos for PLUG-IN fuel cell car



Development of magnesium industry in China

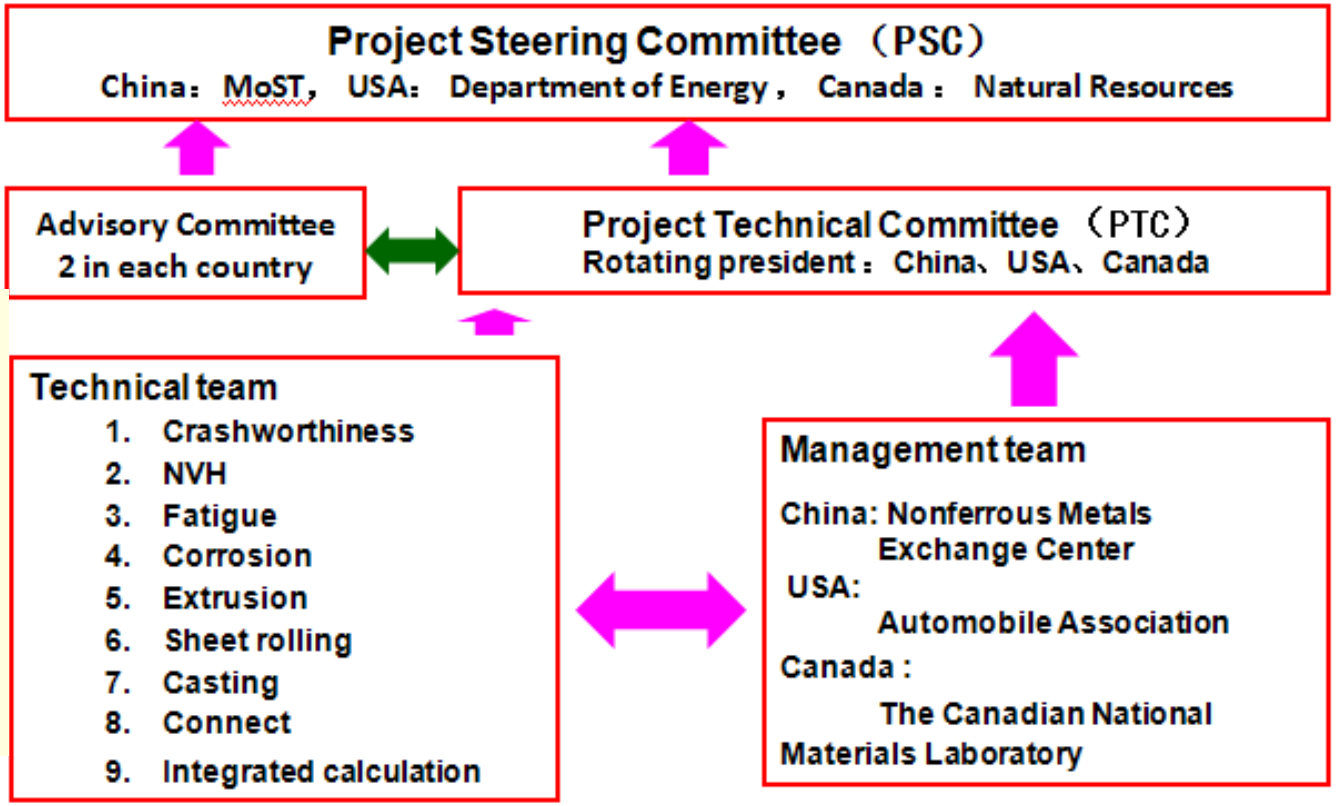
International cooperation 国际合作

Magnesium Front End Research and Development (MFERD)
镁前端研究与开发

China, the United States and Canada
中国、美国、加拿大

Three countries jointly constructed a brand new model of cooperation from the government, Association, to the research task groups.

三个国家共同构建了一个从政府、协会、到研究小组的全新合作模式



Development of magnesium industry in China

International cooperation 国际合作

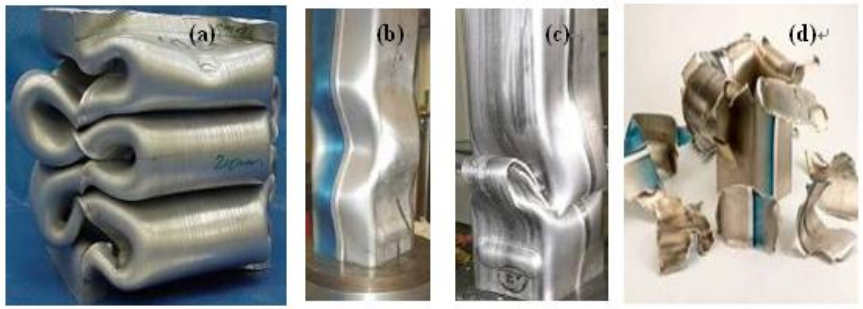
Design from MFERD to demo structure

从前端到示范结构的设计

With the demon structure instead of the real front end, the number of the similar parts, and the joining nodes can be reduced, thus effectively focus on the research and development of the technical problems.

以示范结构代替真实前端，可减少相似件及重复连接节点的数量，进而有效将研发聚焦到技术问题

FSW Structure – as assembled



Gate
决策门

New Design Concept
新的设计理念

Current Mg alloys have limitation in crashworthiness for critical body applications. 镁合金碰撞时的韧性较低，限制了其在车身关键件上的应用

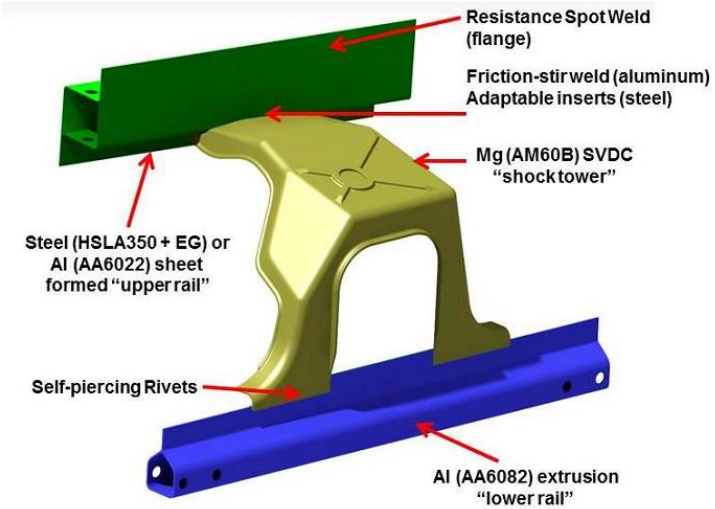
Development of magnesium industry in China

International cooperation 国际合作

Design from magnesium to multi-material demo structure

从单一镁材料到多材料的示范结构

Each material has its own advantages and disadvantages, so an ideal car front end should be a multi-material structure 每一种材料各有优缺点，因此理想的汽车前端应当是一个多材料结构



Shock Tower Die Casting	Casting (Mg) AM60B	Casting (Mg) AM60B
Upper "Rail" Stamped Sheet	Sheet (Al) 6022 T4E40 1.5 mm	Sheet (Steel) HSLA350 70G/70G 1.0 mm Electro Galv
Lower "Rail" Extrusion	Extrusion (Al) 6082 T4 3.0mm	Extrusion (Al) 6082 T4 3.0mm

Multi-material structure will involve more key technologies

- ✓ **Design of multi material system**
  多材料系统设计
- ✓ **Joining between dissimilar alloys**
  异种合金之间的连接
- ✓ **Surface treatment of the demo structure composed of different alloy parts**
  基于不同合金零件示范结构的表面处理

Development of magnesium industry in China

International cooperation 国际合作

Previous photos and annual reports, will server as precious memories, as well as a bridge to looking forward to...

以往的照片及年度报告，仅以此作为珍贵的回忆，及美好的期待…

2011-2015 annual technical progress report

2011-2015年技术进展报告

Development of Aluminum industry in China

中国铝工业发展概况

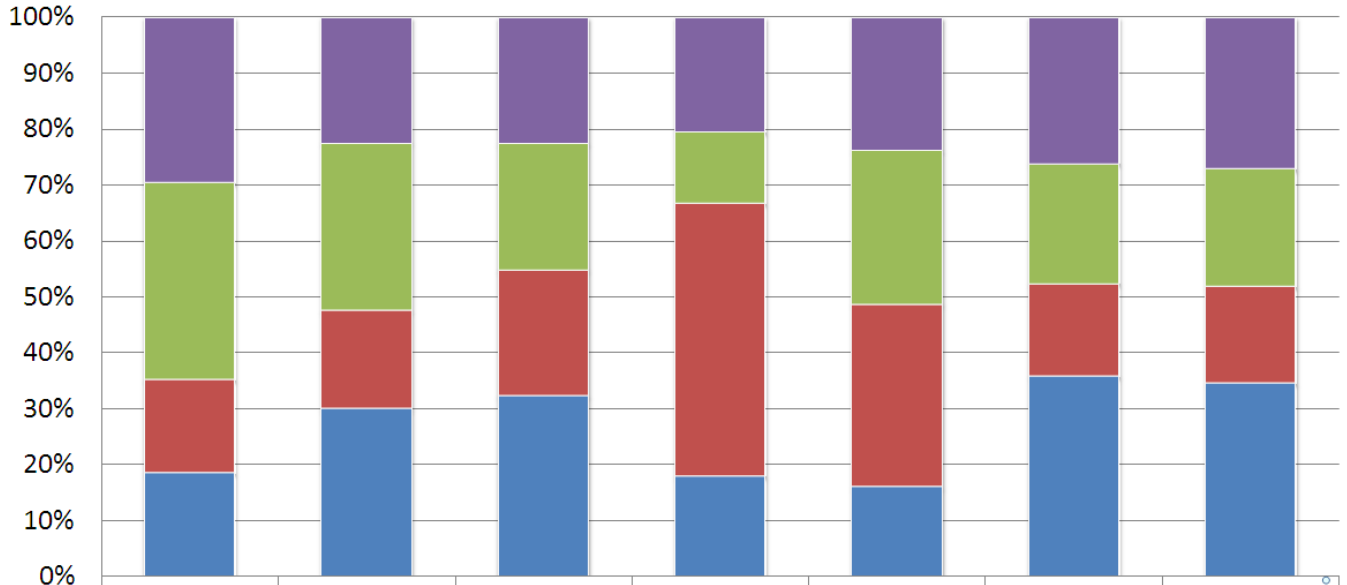
Development of Aluminum industry in China

Consumption structure of aluminum in different countries

不同国家铝的消费结构

The Al consumption is mainly includes construction, transportation, packaging, electric power, durable consumer goods, machinery and so on. Chinese aluminum consumption in the transportation industry is much smaller than that in the western countries, while the consumption in the construction engineering industry is much greater than that in the western countries.

铝的消费主要包括建筑、交通运输、包装、电力、耐用消费品、机械等。中国在交通运输领域的铝消耗远小于西方国家，在建筑领域的消耗远大于西方国家



	Other 其它	Mechanics 机械	Durable consumer goods 耐用消费品	Packing 包装	Transportation 交通运输	Power 电力	Architecture 建筑
Global 全球	16	9	7	8	27	11	22
Europe 欧洲	19	12	7	5	31	9	17
USA 美国	9	7	7	19	37	7	14
China 中国	10	12	10	7	18	15	28

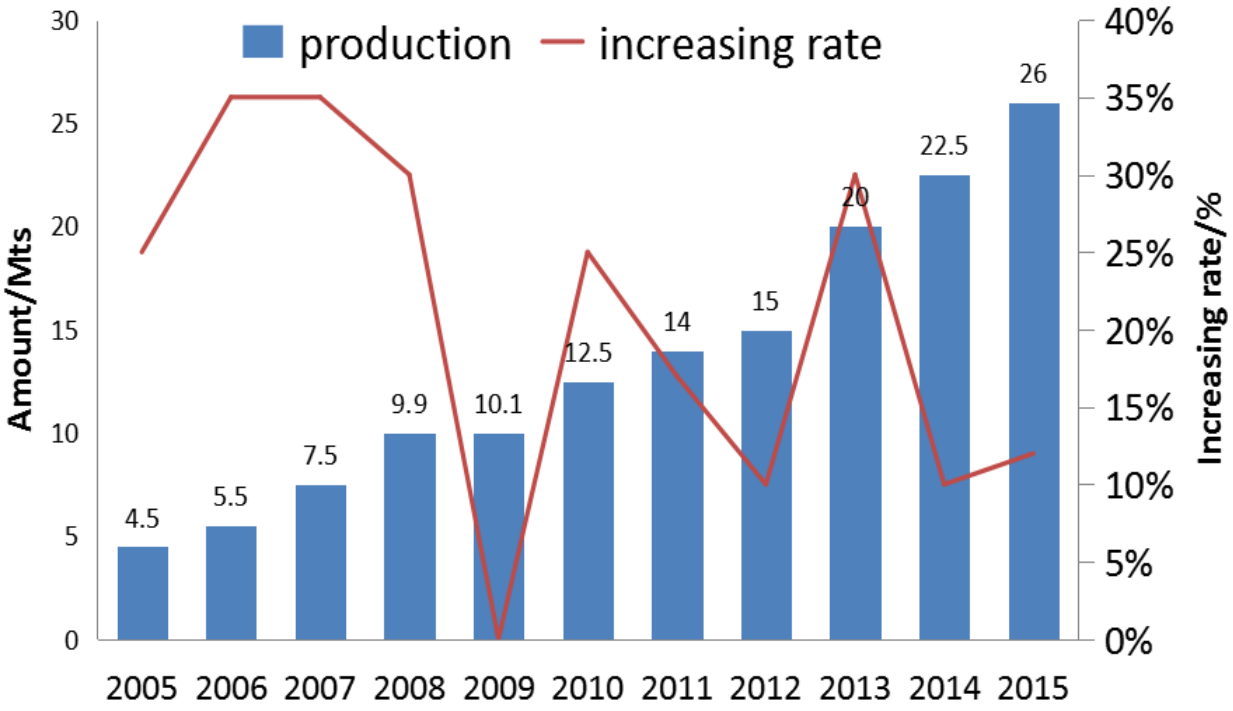
Development of Aluminum industry in China

Output of extruded product in China

China is a major producer of aluminum profiles, and the export volume increases year by year.**中国是铝型材生产大国，出口量连年递增**

Even though China is a major producer of aluminum alloy extruded products, China still has to import large aluminum profiles for high-speed train and track transportation, etc...

尽管中国是铝合金 挤 压材的生产大国，中国还是不得不大量进口高速列车和轨道交通 上 的 大规格型材



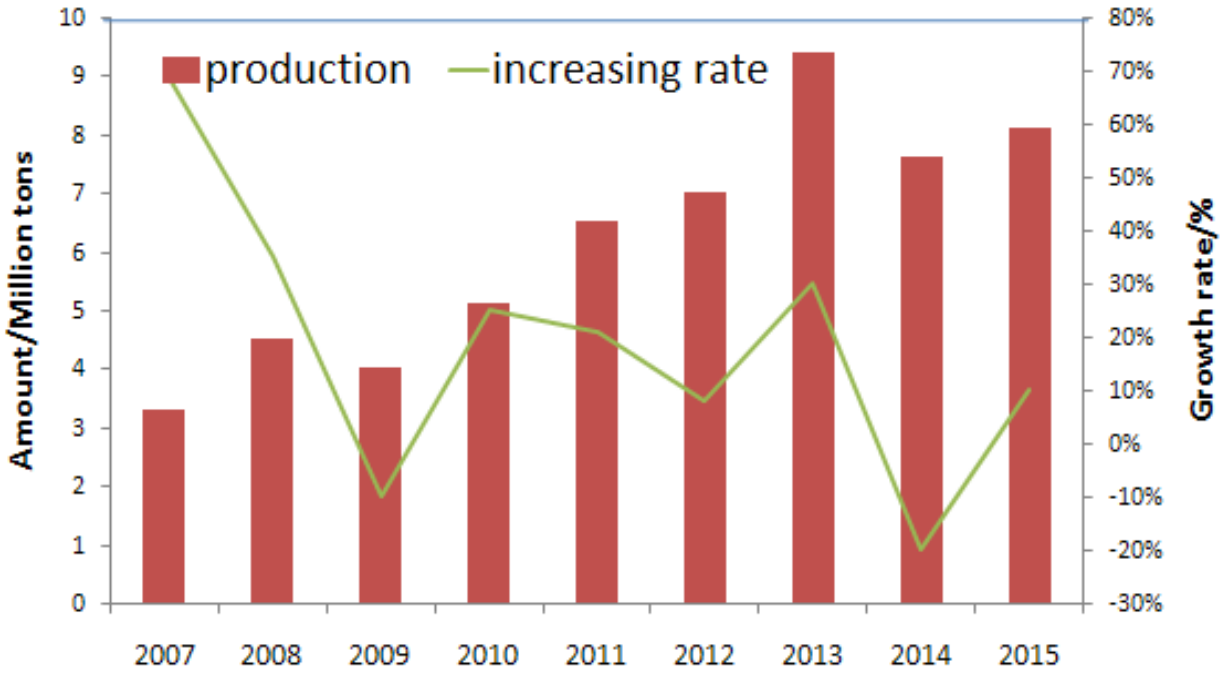
Development of Aluminum industry in China

China has also become the world's largest aluminum plate and strip production country.

中国也是世界上最大的铝板带材的生产国

China has also become a major of aluminum alloy plate and strip producer..Even though China still has to import a large number of high-grade aluminum products, such as thick plates for aircraft, etc...

尽管中国是铝合金板带材生产大国，中国还是不得不大量进口高档的铝产品，例如飞机上的厚板等

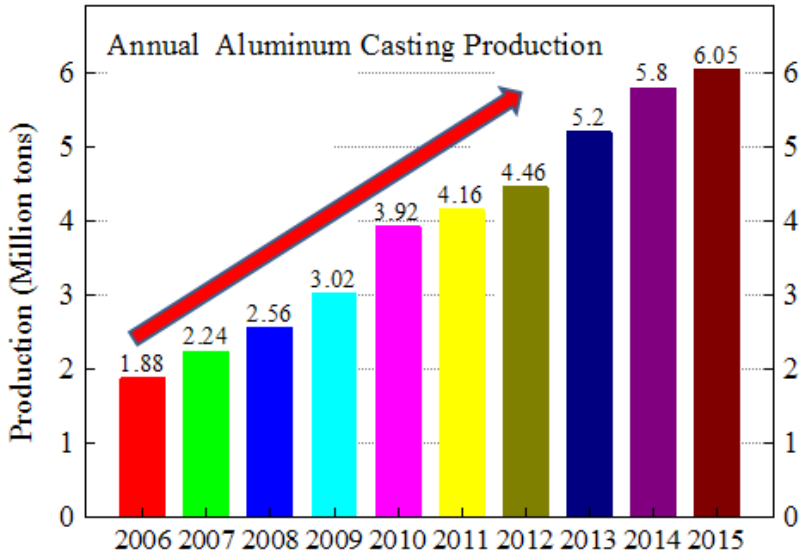


Development of Aluminum industry in China

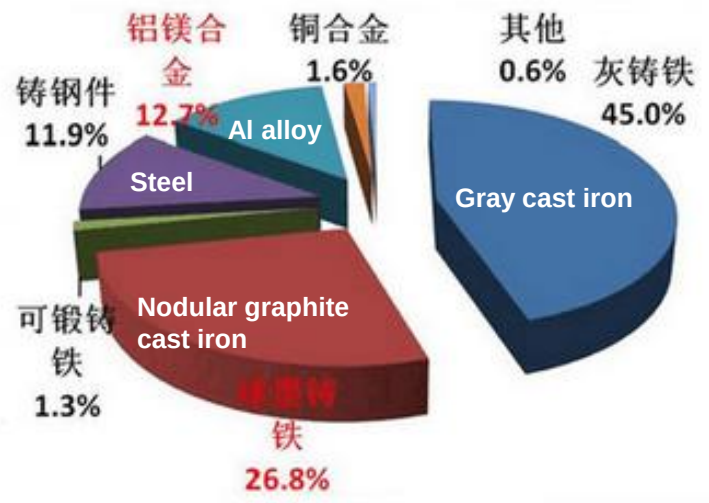
aluminum casting in China 中国铝合金铸件概况

China is a major producer for all kinds of castings. Among them, the amount of aluminum castings has the fastest growing. The proportion of aluminum castings is only lower than that of cast iron in all kinds of castings.

中国是各类铸件生产大国。其中，铝铸件增长最快，所占比例仅次于铸铁



- Growth rate /Y: the worldwide is 3%, China is 4.27% (2015);
- Ratio of aluminum castings/castings: major countries is 13-19%, China is 13.4% (2015) ;
- China is expected to reach 8 million tons in 2020;



The proportion of all kinds of different materials in China in 2014

2014年中国各类材质铸件占比图

Development of Titanium industry in China

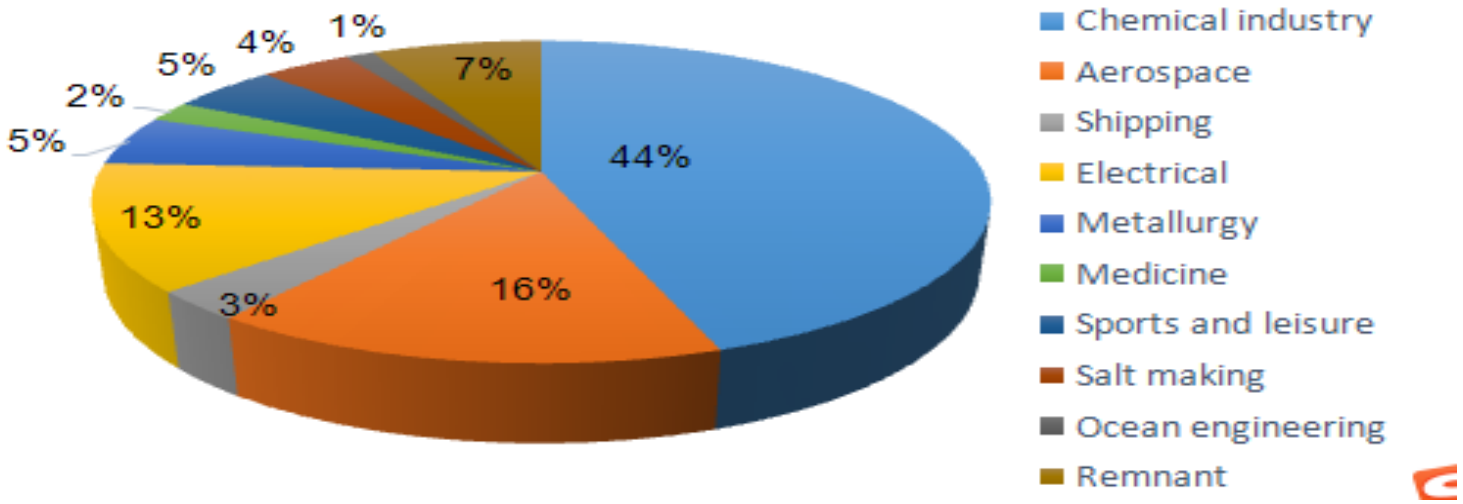
中国钛工业发展概况

Development of Titanium industry in China

Application in China 中国应用情况

By 2015, chemical industry was the largest application field of titanium in China. However, the special demands of titanium alloys in the aerospace and deep sea areas will be increased rapidly.

至2015年，化工仍是钛在中国最大应用领域。未来，钛合金在空天和深海将会增长



Ratio of China titanium mill products in different application fields in 2015

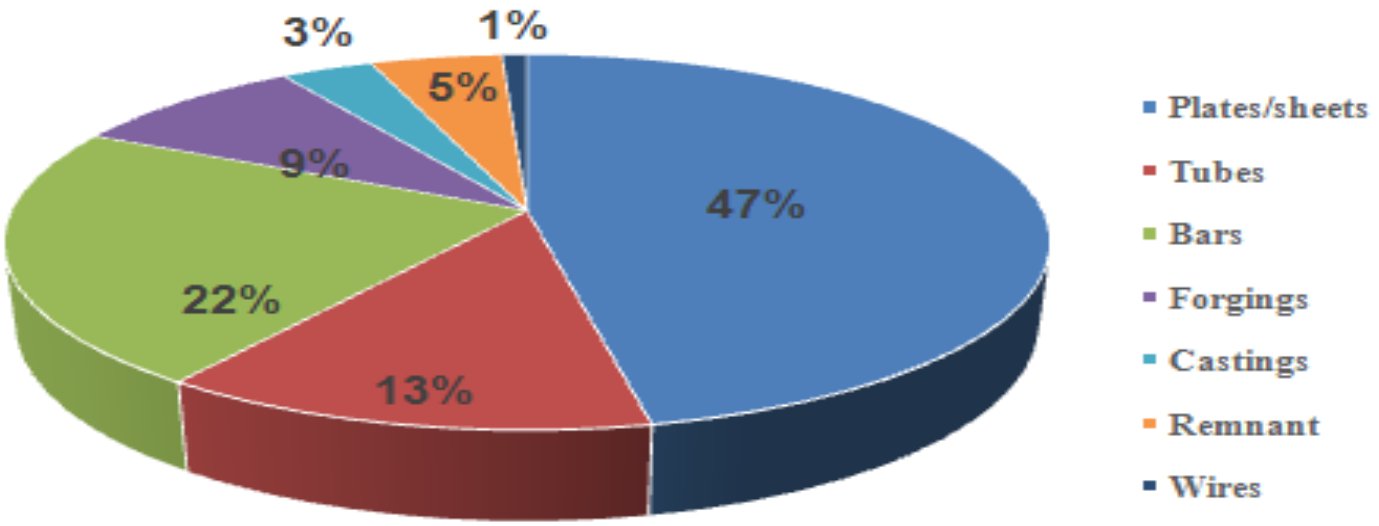
2015年我国钛材产品在不同应用领域的比例

Development of Titanium industry in China

Application in China 中国应用情况

Among them, the proportion from high to low order is: plates, tubes, sheets, bars, forgings, castings, wires, etc...

其中，各类产品所占比例从高至低依次是：板材、管材、棒材、锻件、铸件、线材等



Proportions of different titanium products of China in 2015

2015年中国不同种类钛产品所占的比例

Development of Titanium industry in China

Application in China 中国应用情况

TC17, Φ500mm

Φ470×29×11000 mm

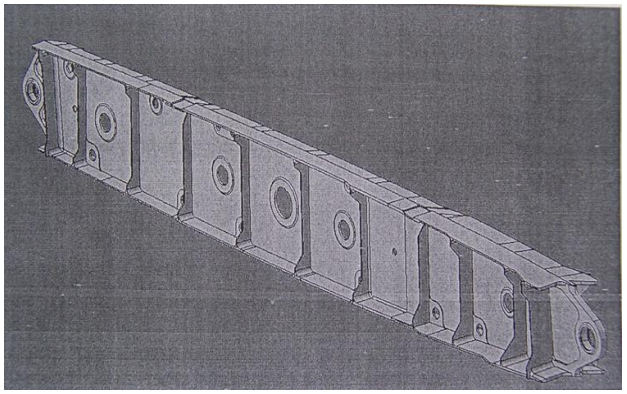
Shape memory coupling

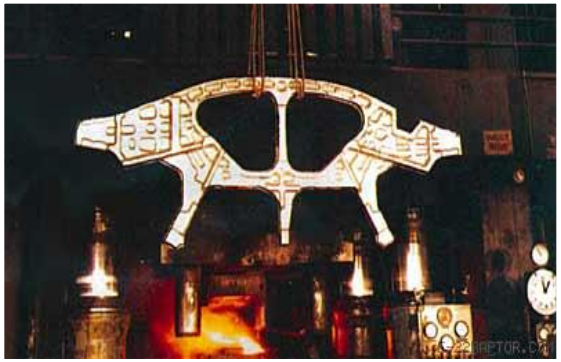
TC4：90×3200×3450mm

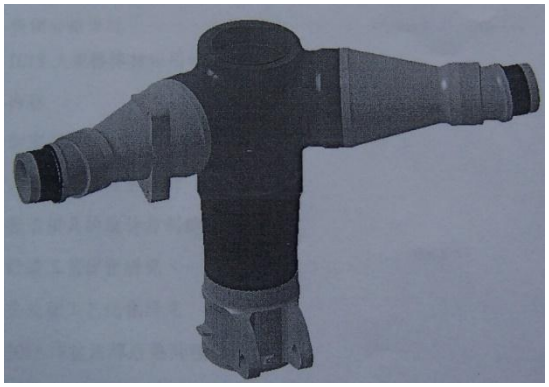
Strip coil

Development of Titanium industry in China

☐ Aircraft structural parts 飞机结构件

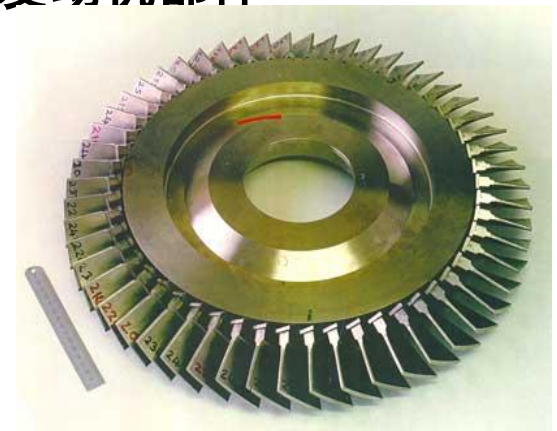






☐ Aero engine structural parts 飞机发动机部件

High-pressure compressor



Titanium blisks for compressor

Development of Titanium industry in China

Deep-diving manned submersible 深海载人潜水器

Key Direction of the 13th Five-Year Plan

十三五重点发展方向

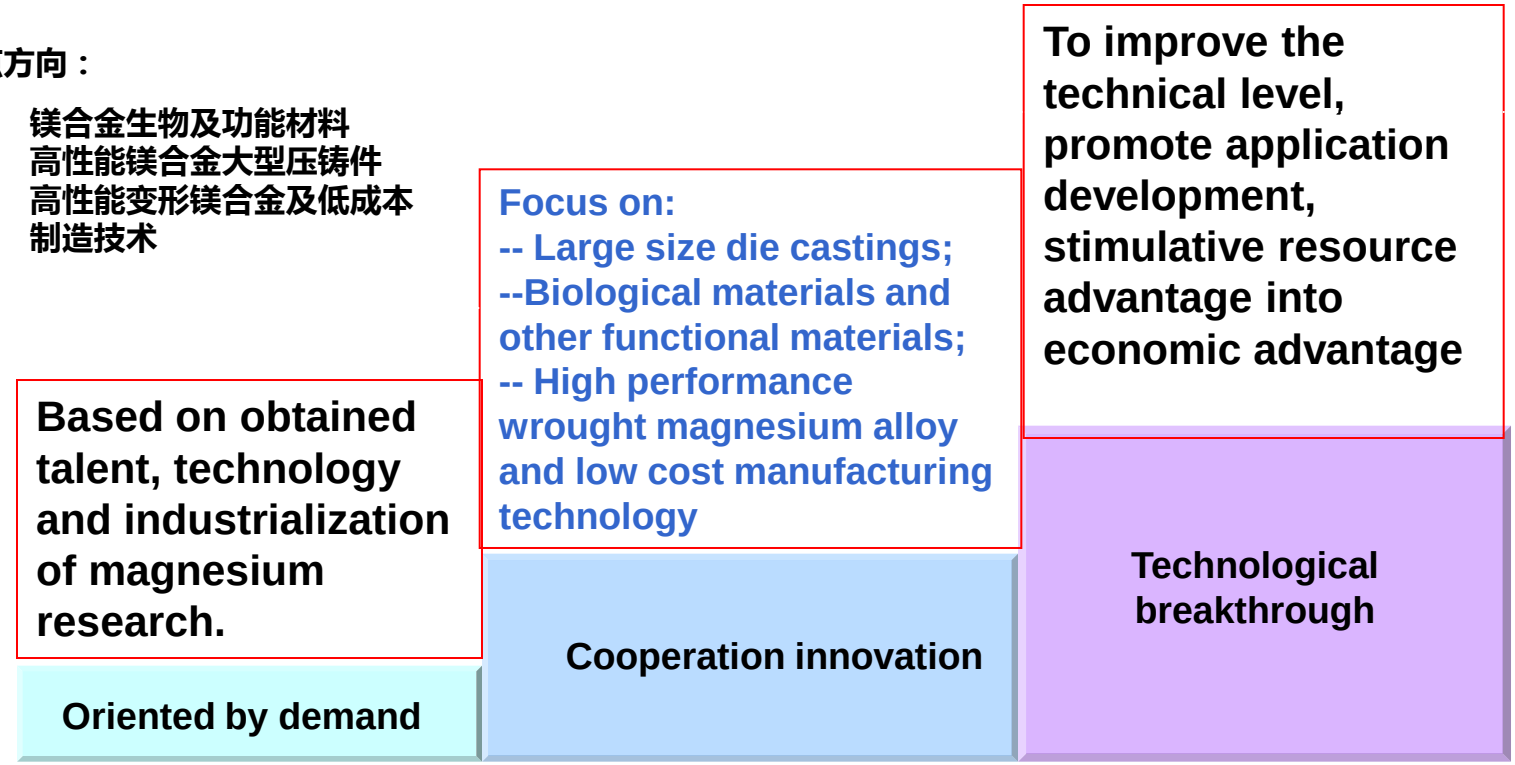
Key direction of the 13th Five-Year Plan

Development strategy

A materials technology progress to promote rapid development of magnesium alloy application

重点方向：

- **镁合金生物及功能材料**
- **高性能镁合金大型压铸件**
- **高性能变形镁合金及低成本制造技术**



Making full use of our country magnesium resource advantage, comply with general trend of energy saving and low carbon economy.

Key direction of the 13th Five-Year Plan

Development strategy

A materials technology progress to promote rapid development of aluminum alloy application

重点方向：

- 快速时效铝合金薄板
- 超高强预拉伸铝合金厚板
- 覆盖件拉伸及烤漆硬化
- 大型结构件残余应力削减

Based on obtained talent, technology and industrialization of aluminum research.

Oriented by demand

Focus on:
-- the rapid aging of aluminum alloy sheet, super high strength pre stretched aluminum alloy plate;
--covering parts drawing deformation and body paint hardening;
-- residual stress reduction of large-scale structure

Cooperation innovation

To improve the technical level, promote application development, production advantage into technology advantage

Technological breakthrough

Making full use of our country aluminum production advantage, comply with the general trend of energy saving and low carbon economy.

Key direction of the 13th Five-Year Plan

Development strategy

A materials technology progress to promote rapid development of titanium alloy application

重点方向：

- 海洋石油钻探用耐蚀钛合金大直径无缝管
- 海洋工程和海水淡化装备用高性能卷焊钛管
- 大卷重、低成本钛带

Based on obtained talent, technology and industrialization of titanium research.

Focus on:
-- the large diameter seamless titanium alloy pipe for offshore oil drilling
-- high performance coil welding titanium pipe for marine engineering
-- large coil and low cost titanium strip

To improve the technical level, promote application development, production advantage into technology advantage

Oriented by demand

Cooperation innovation

Technological breakthrough

Making full use of our country titanium production advantage, comply with the general trend of energy saving and low carbon economy.

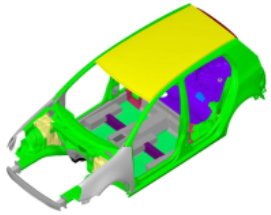
Key direction of the 13th Five-Year Plan

Development strategy

At the end of 2007, EU proposed a concept of "multi-material" in the research of and development of a super light body. It will be a good model for the future development of materials. Combining the advantages of magnesium alloy, aluminum alloy, and titanium alloy will be the best way to realize automobile lightweighting.

2007年底，欧洲在超轻车身研究中提出了一个“多材料”的概念。这将成为未来材料发展的一个很好模型。将镁合金、铝合金、钛合金等的优势结合起来，将成为 实现轻量化的最佳途径

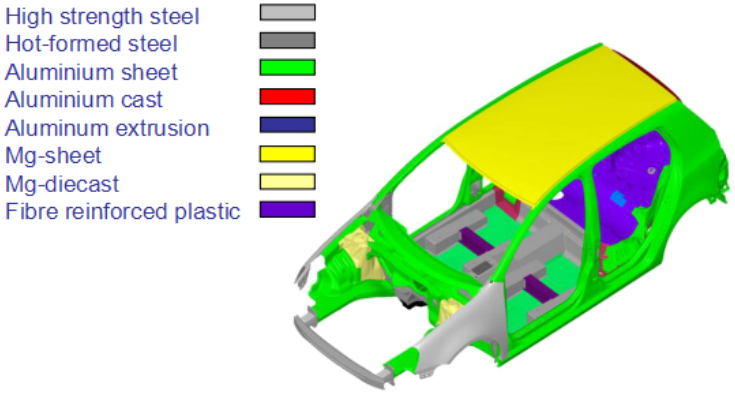
SLC body structure concept
超轻车身结构概念



Weight reduction: ~30%

Additional part costs: **< 5,0 €/kg**

Highlights:
- Mg-Strut tower (die cast)
- Mg-Roof
- Hot formed steel door aperture
- FR plastic roof cross beam
- FR plastic rear floor
- Al-Casting rear longitudinal
- Polymer reinforced seat cross-member



Material Mix:

Steel parts weight:	approx. 50 %
Al parts weight:	approx. 35 %
Mg parts weight:	approx. 8 %
Plastic parts weight:	approx. 7 %

Thanks for your attention!