Self-reliance: Capacity is no longer a solution

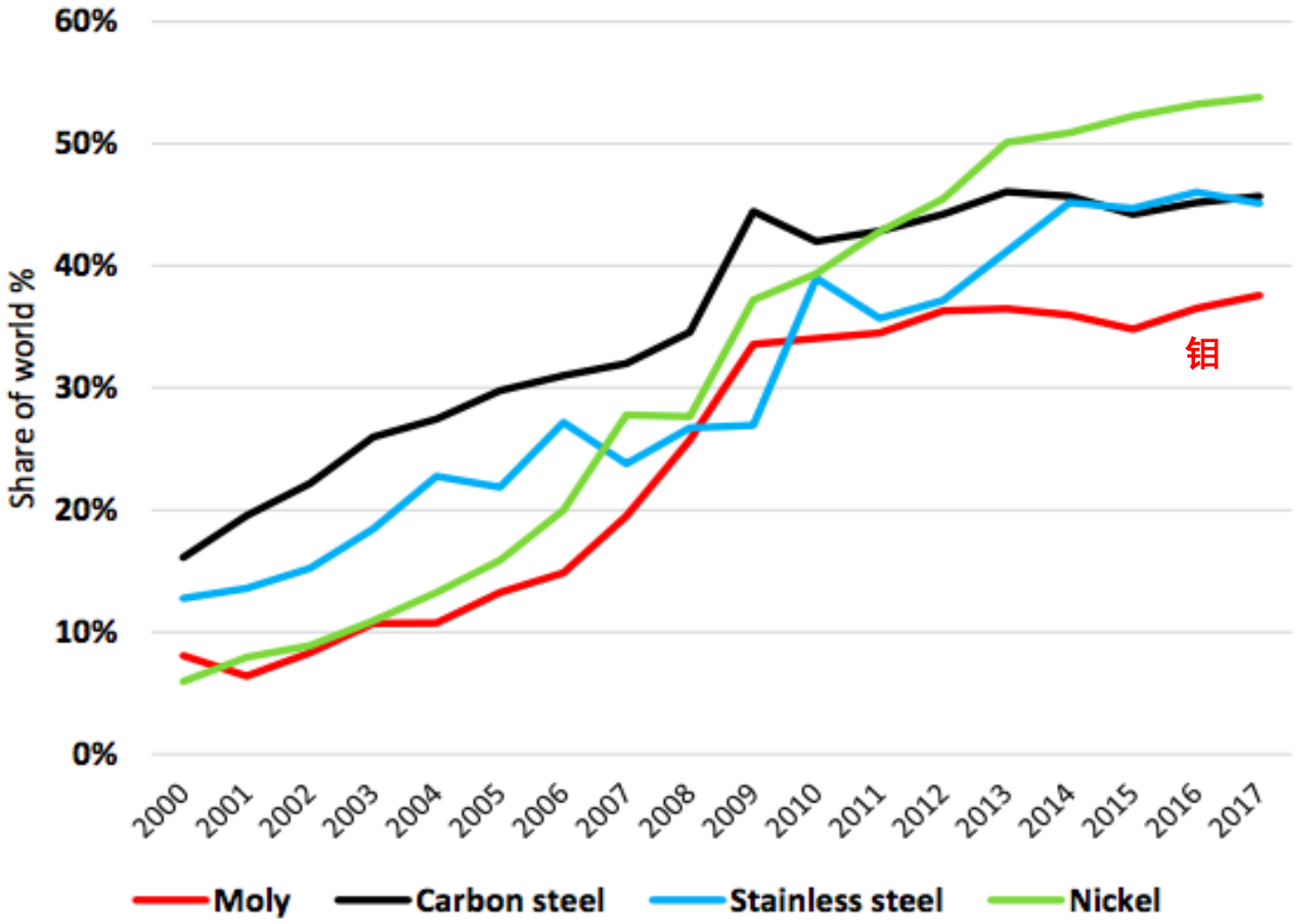
自力更生：产能不再是解决方案

G. Ronchi – 珠海 2019. 3. 7

自力更生：钼与钢 Self-reliance: Moly and Steel

全球钼消费量中，中国只占很小份额

China's share in global Moly use is low

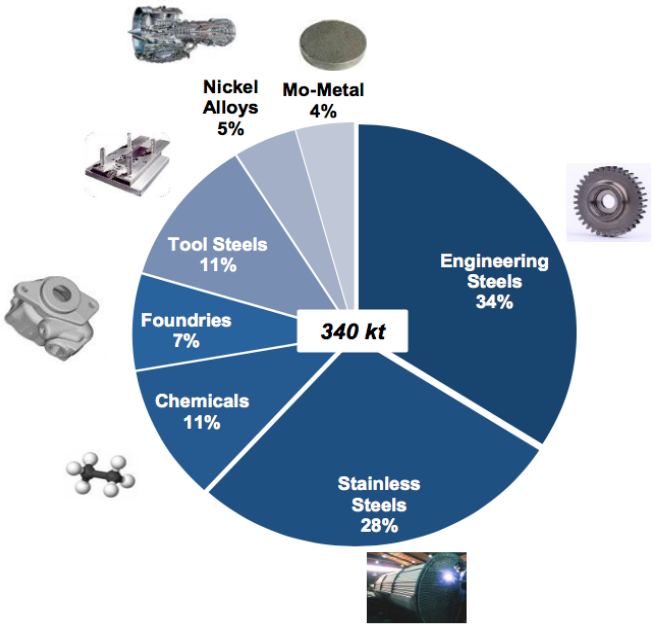


Source: CRU, IMOA , Red Door Research

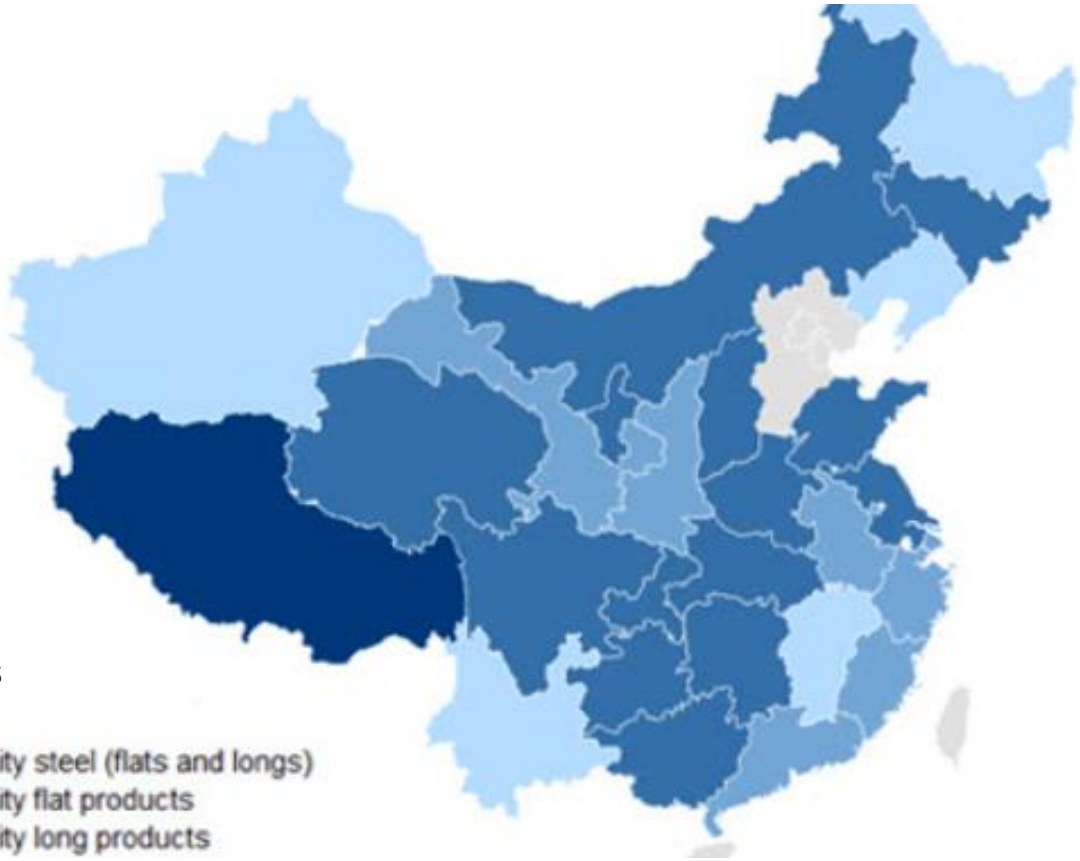
自力更生：钼与钢 Self-reliance: Moly and Steel

工信部：更新的《产业转型指南》China's Ministry of Industry and Information Technology: an updated "Industry Transformation Guide" (The Guide).

中国钢材的需求正面临着从商品级钢材向高端优质钢材的结构性转变，主要集中在先进的设备和机械制造业以及高技术产业。 China's steel demand is facing a structural shift from commercial-grade steels towards higher-end and better-quality steel in advanced equipment and machinery manufacturing and in high technology industries



2017年钼初次消费量：钢铁占主导
Mo Global First Use (2017): steel dominates



自力更生：钼与钢 Self-reliance: Moly and Steel

中国钢铁行业钼消费量与国际水平的差距 The PRC's Steel Industry and the Moly Gap Question

	Moly 2017 (Tons)		Crude Steel 2017 (Million Tons)		Kg Mo / Ton Steel
Europe	57,681	21%	171	10%	0.34
Total Exc China	189,592	69%	860	51%	0.22
China	84,441	31%	830	49%	0.10
Total	274,032	100%	1690	100%	0.16

Source SMR – End-use of Molybdenum; WORLD STEEL

钼是高端钢发展的战略驱动剂，发展高端钢是中国钼行业不可错过的双赢机遇！ Moly is a strategic driver for High End Steels developments, a win win that the Chinese Moly industry shall not miss!

自力更生：钼与钢 Self-reliance: Moly and Steel

2018年中国钼在钢铁中的消费量= 72000 t （占总量的 85%)
2018 China's Mo consumption in Steel

Break down per segment

	2010	2018	Gr 2010-17	Share 2018
	Tonnes	Tonnes	%	%
Alloy& Engin. Steel	**26988**	**35082**	2.0%	**49%**
Stainless steel	**20205**	**28514**	3.0%	**40%**
Cast iron	**7327**	**8404**	0.6%	**12%**
Total	**54520**	**72000**	2.2%	**100%**

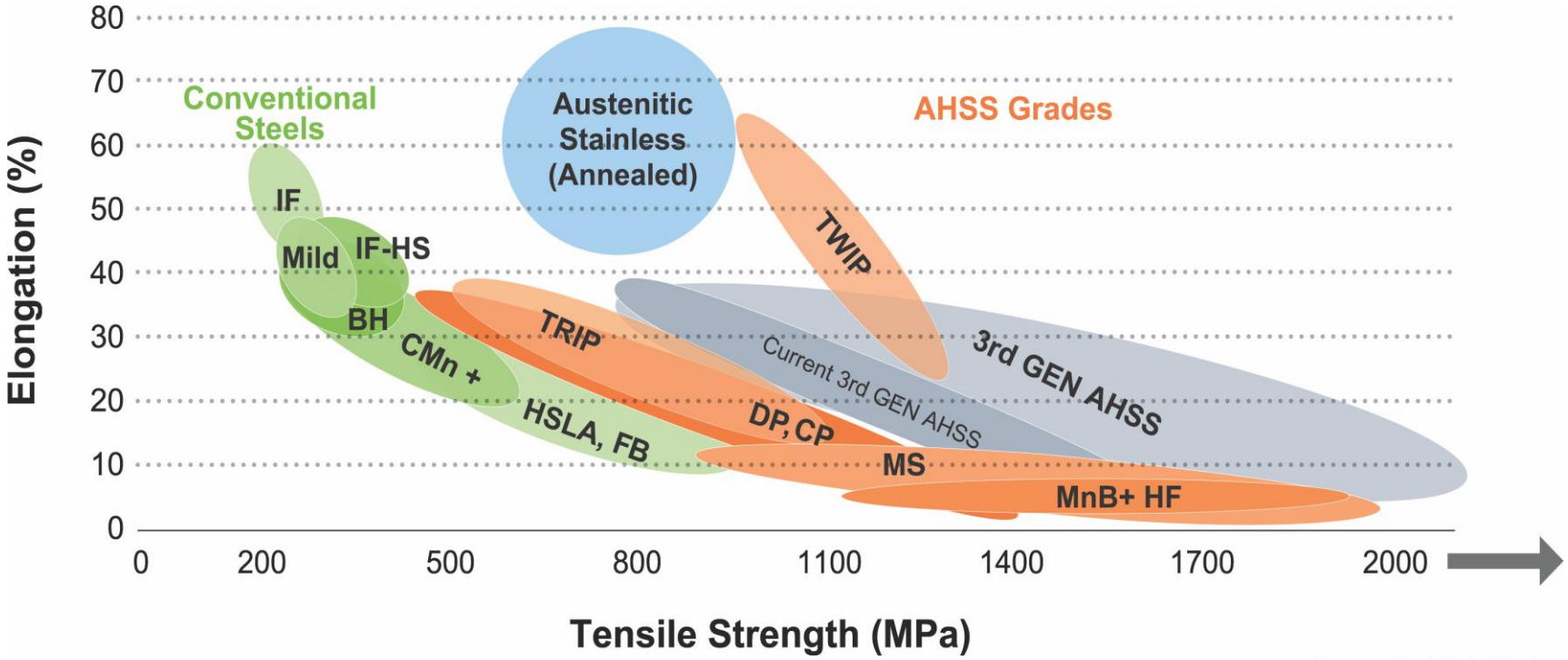
自力更生：钼与钢 Self-reliance: Moly and Steel

什么是高端钢？ What high end steel are?

高端钢是复杂特殊的材料，其化学成分经过经心设计，多相微观结构是由精确控制的加热和冷却工艺产生的

High end steels are complex, sophisticated materials, with carefully selected *chemical compositions* and *multiphase microstructures* resulting from precisely *controlled heating and cooling* processes.

钢的“强度韧性图” The Steel “Strength Ductility Diagram”



Source: WorldAutoSteel

自力更生：钼与钢 Self-reliance: Moly and Steel

钢的“强韧”博弈 The Steel “Strength Ductility” challenge

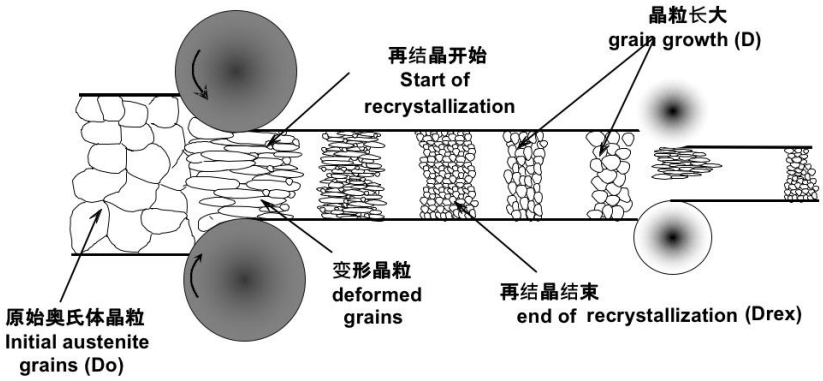
通过订制的合金化和轧制工艺提高强韧性 Improved strength-ductility combinations are achieved with special combinations of alloying & thermo-mechanical processing

一次合金元素 PRIMARY ALLOYING AGENTS
Carbon, Manganese, Silicon

二次合金元素 SECONDARY ALLOYING AGENTS
Copper, Nickel, Chromium, Molybdenum, Vanadium, Niobium, Aluminum, Boron Cobalt, Tungsten

+

杂质元素 TRAMP ELEMENTS
Sulphur, Phosphorous, Tin, Lead, Zinc

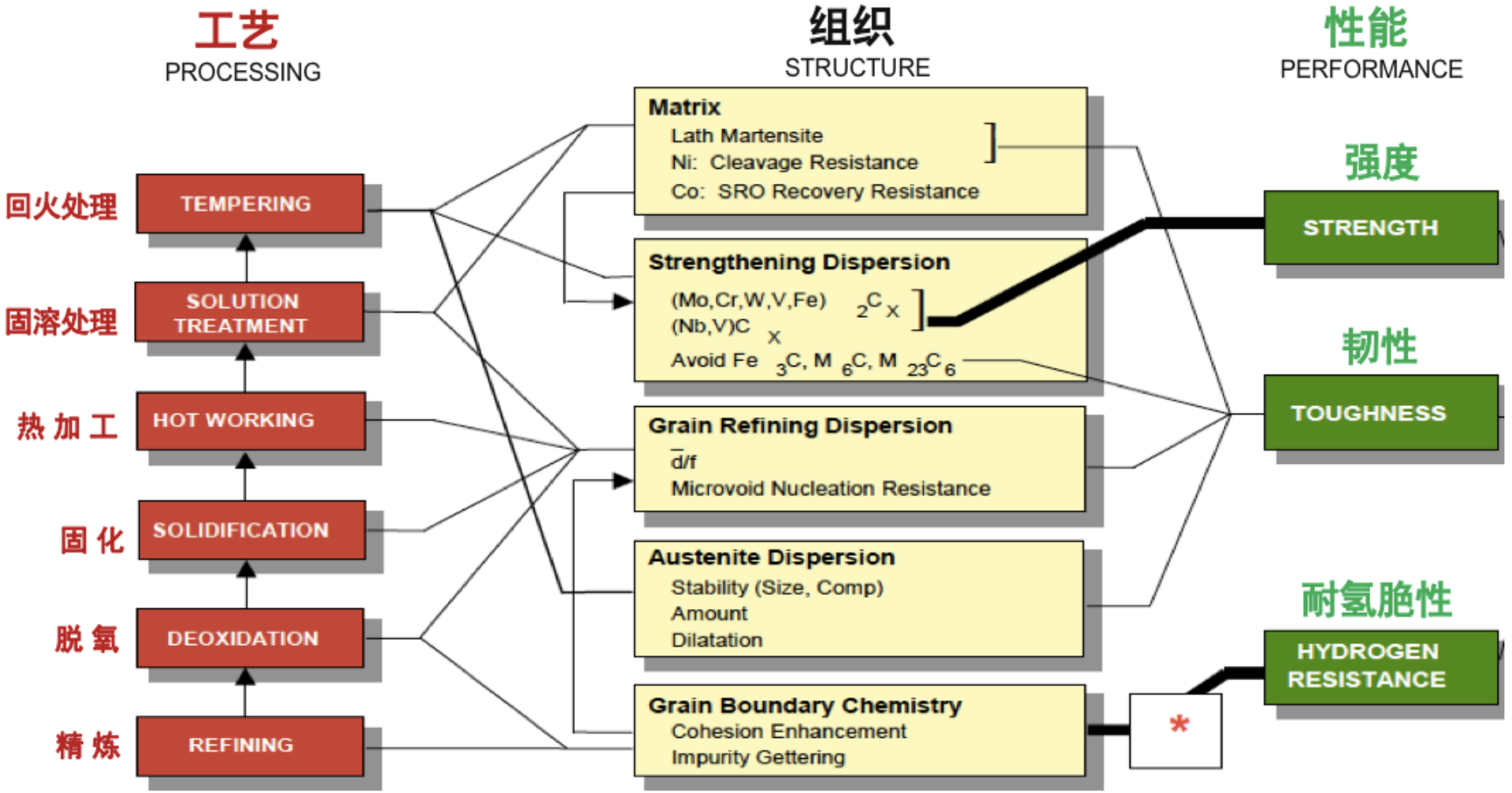


HSLA	High Strength, Low Alloy
DP	Dual Phase
CP	Complex Phase
FB	Ferritic Bainitic
Q&P	Quenching & Partitioning
TRIP	Transformation Induced Plasticity
MS	Martensitic (MART)
TWIP	Twinning-Induced Plasticity
HF	Hot Formed (and quenched)
TPN	Three Phase Nano-Precipitation

自力更生：钼与钢 Self-reliance: Moly and Steel

钢企不在乎钼，他们走自己的工艺路线

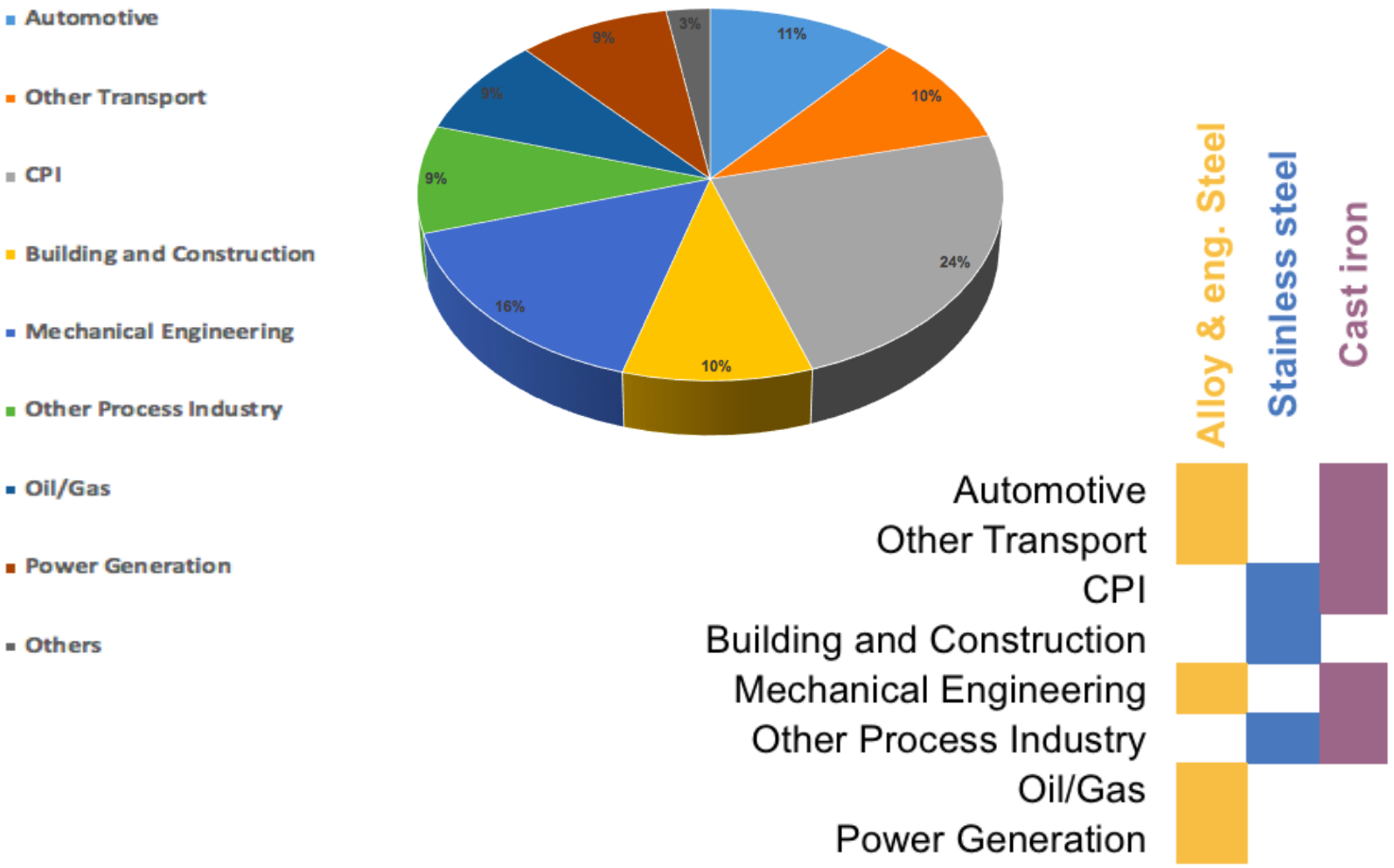
Steel producers do not care about Moly, they go their own way!



钼与钢：市场开发 Moly and Steel: market development

2018年中国钢铁行业的钼消费量为7.2万吨，占总量的85%。
2018 China Mo consumption in Steel 72000 t (a 85% of total)

应用领域划分 Break down per segment



上海钼与钢高端论坛（2018年11月28-29日）
搭建了一座通往高端钢铁材料的国际桥梁
An international bridge towards High End Steels

“2018 钼与钢高端论坛” 部分议程

11月28日乐予新楼大学厅			
全 天	参会代表报到，办理入住手续		
18:30~	欢迎晚宴		
11月29日乐予新楼学海厅会议室（主持人：）			
时间	内容/报告题目	报告人	单位
08:30~09:00	开幕致辞	赵 沛 秘书长 Tim Outteridge	中国金属学会 金堆城钼业集团 国际钼协会 秘书长
09:00~09:30	大会主题报告	董 瀚 院长	上海大学材料学院
09:00~10:00	大会主题报告	Hardy Mohrbacher	比利时NiobelConbvba公司
10:00~10:20	茶 歇		
先进碳钢的发展主题特邀报告（主持人：Hardy Mohrbacher 教授）			
10:20~10:45	特邀报告	Pello Uranga	西班牙CEIT公司
10:40~11:05	特邀报告	侯成豪 教授	北京理工大学
11:05~11:30	特邀报告	王 利 首席研究员	宝武集团中央研究院
11:30~11:55	特邀报告	Takehide Semura教授	日本冈山大学
自助午餐 参观上海大学先进凝固技术中心			
特殊钢铸件的研发、生产及应用主题特邀报告（主持人：翟启杰教授）			
14:00~14:15	特邀报告		上海大学先进凝固技术中心
14:15~14:35	特邀报告		国内知名企业
14:35~14:55	特邀报告		国内知名企业
高性能工程用钢主题特邀报告（主持人：郭爱民教授）			
14:55~15:25	特邀报告	Frank Hippenstiel	德国BGH 优质钢有限公司
15:25~15:55	特邀报告	杨哲人 教授	台湾国立大学
15:55~16:25	特邀报告	黄 正 高工	中国汽车行业资深专家
16:25~16:55	特邀报告	Thiery Crémailh	德国斯塔 萨拉柏钢铁集团
16:55~17:10	致闭幕辞	Nicole Kisnman	国际钼协会技术总监

先进高强钢
Advanced high strength steels (AHSS)

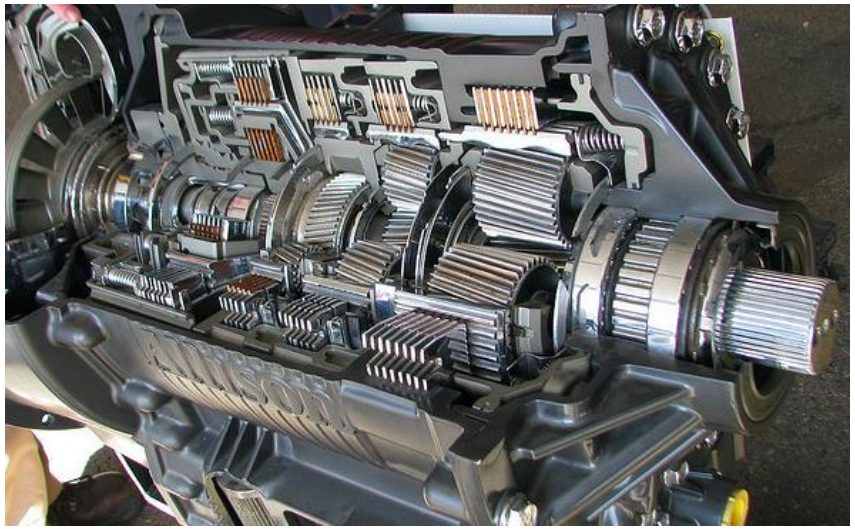
工程钢和工具钢
Engineering and tool steels

铸铁
Cast iron

开发大型齿轮用钢 Development for large gear applications

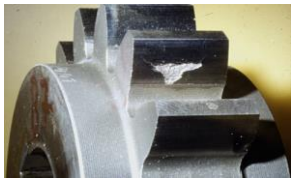
高性能齿轮钢

Gear steels with increased performance

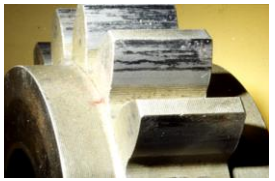


齿轮失效形式 Main Gear Failure Modes

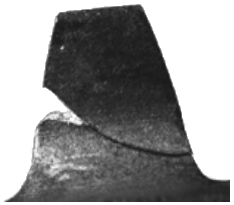
Pitting



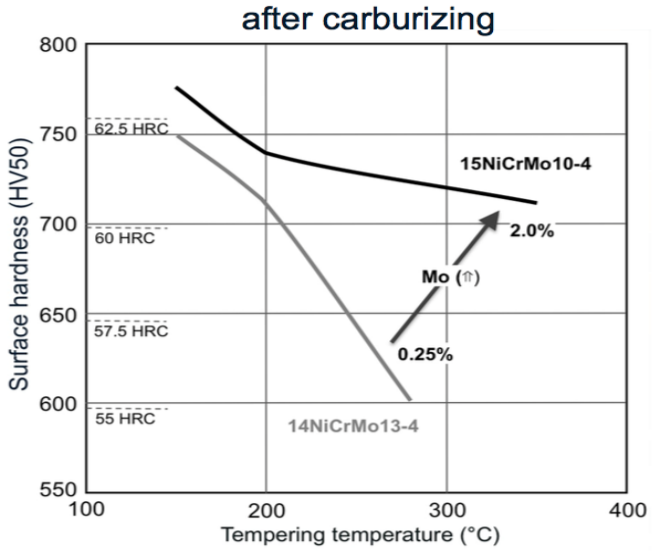
Micro-pitting



Flank fracture



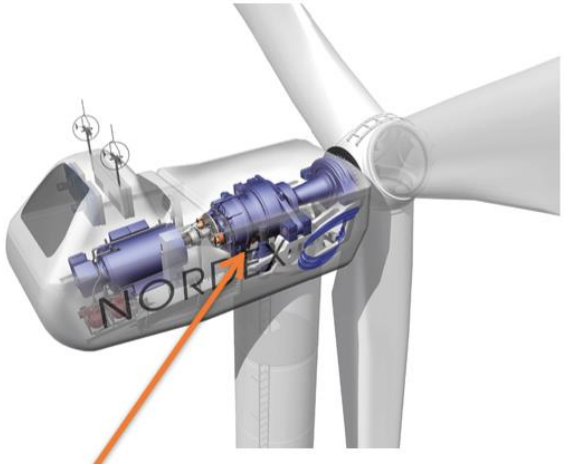
Root breakage



- 提高磨齿效率
  Improved efficiency of gear making process.
- 提高大型设备的可靠性
  Increased reliability in expensive capital equipment.

开发大型齿轮用钢Development for large gear applications

高性能齿轮钢
Gear steels with increased performance



A）南京齿轮厂开发项目
Development project at Nanjing gears

齿轮箱是最关键的部件。30%的停机时间与齿轮箱故障有关。齿轮箱更换成本为28-30万欧元。更好的齿轮钢（渗碳钢）正在开发中。

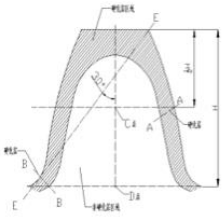
Gear box is the most critical component. 30% of downtime related to gear box failure. Gear box exchange costs 280-300 k€. Better gear steel (cas carburizing steel) is under development.

钢的用量：300t/ 兆瓦　Steel consumption: ca. 300 t per installed MW

热处理技术指标
heat treatment requirements

Fast

硬化层深 depth of case hardened：1.15-1.65mm；
表面硬度 surface hardness：62-65HRC；
心部硬度 core hardness
C点 C point：30-45HRC
D点 D point：≥25HRC
残余奥氏体 retained austenite：over level E（≤30%）
晶间氧化 grain-boundary oxides：≤20μm



B) 陕西法士特公司决定用新型材料V1（含钼0.54%）进行产品试制。按年产量20万吨计算，钼消费量为800吨/年。

B)Development project at Shaanxi FAST Auto Drive Group Company, China's largest production enterprise for heavy-duty auto transmissions, auto gears, forgings and castings.

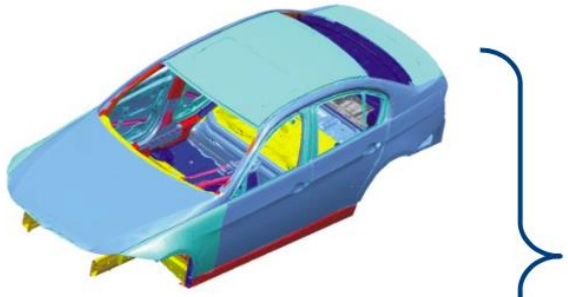
陕西法士特项目2018年7月23日在陕西宝鸡启动

The FAST Project July 23d, 2018 Kick-off at Baoji (Shaanxi)

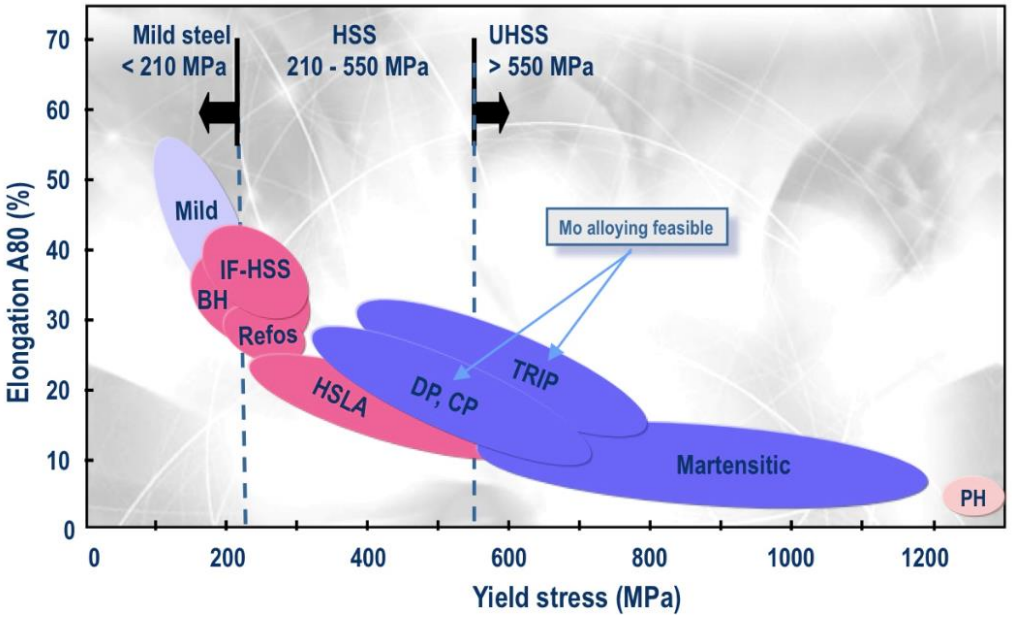
先进高强钢 Advanced high strength steels (AHSS)

汽车板系列 Automotive sheet steel families

- Low-medium strength
- High formability



- Medium-high strength
- Medium formability
- Crash resistance
- Energy absorption



制造具体零部件的钢种取决于汽车制造商及其生产的车辆类型。Steel type used to make a particular part varies depending on the car manufacturer and the types of vehicles they produce.

最近，北欧一家著名钢厂生产的结构钢：0.7%钼，屈服强度≥1100兆帕。尽管其强度很高，但易于焊接和弯曲。这将对桥梁等结构应用产生重大推动作用。

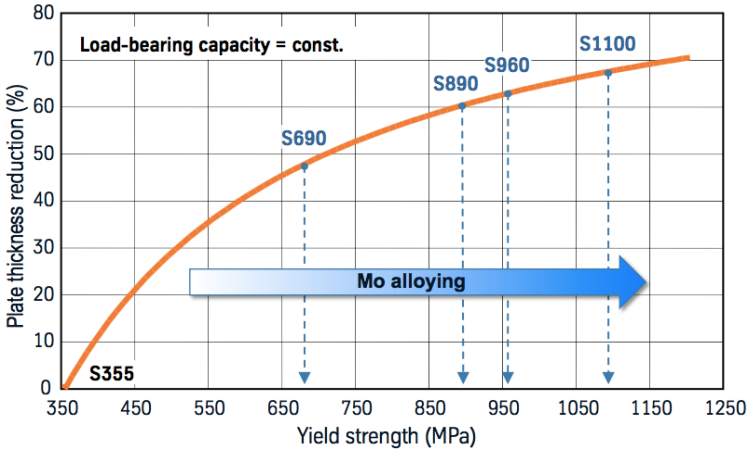
A structural steel with 0.7% Mo and a high yield strength at a minimum of 1100 Mpa has been recently made available by a well known Scandinavian steel mill: despite its strength, the material is easy to weld and bend. This leads also to important developments in the structural applications as bridges for example.

先进高强钢：促进结构应用和焊接技术的发展

AHSS : structural applications and welding developments

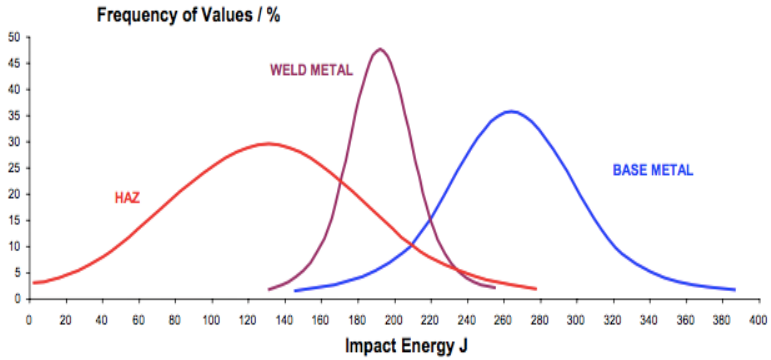
高强钢减轻结构重量

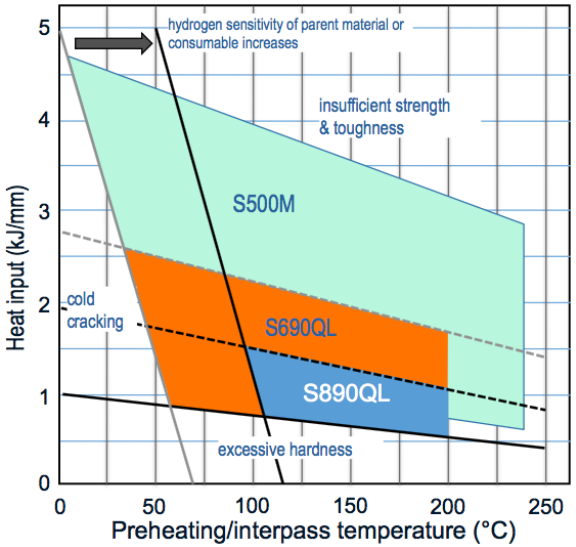
Structural weight reduction by high strength steel



高强结构钢的可焊接性

Weldability of high strength structural steel





正在与珠海焊接协会探讨合作开发项目

We are just now considering a development project with the Zhuhahi welding association

含钼耐候结构钢 Weathering structural steels with Mo

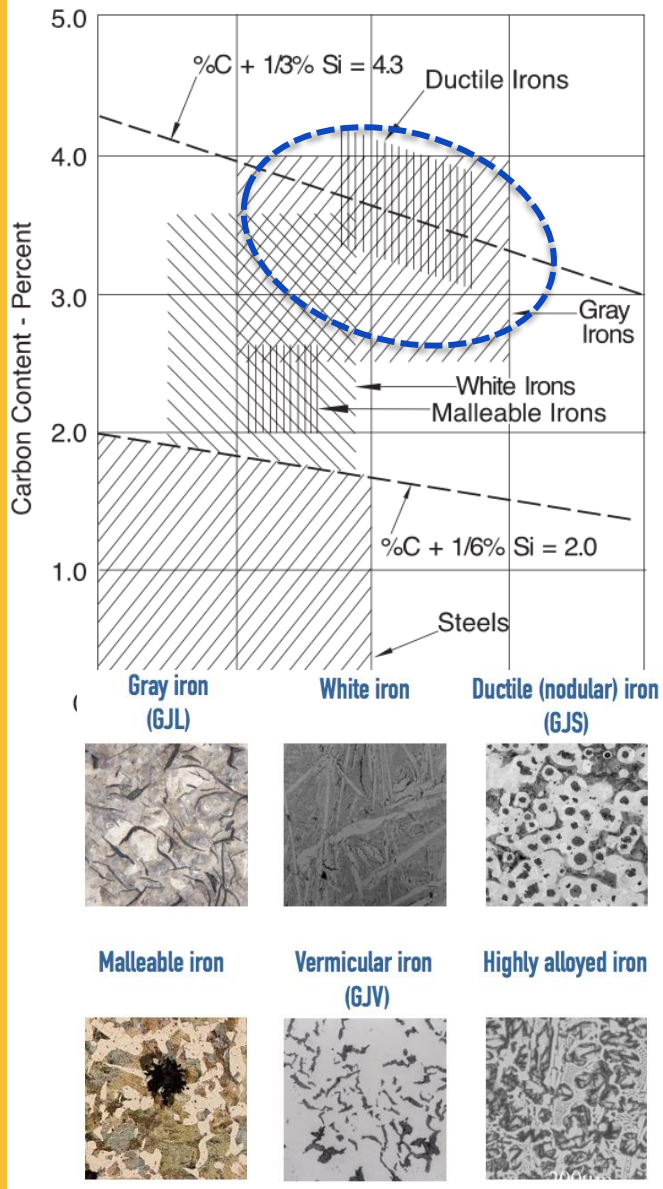
安徽铁塔（首钢）460MPa, 2017, demo tower in Anhui

耐候钢桥梁（鞍钢）

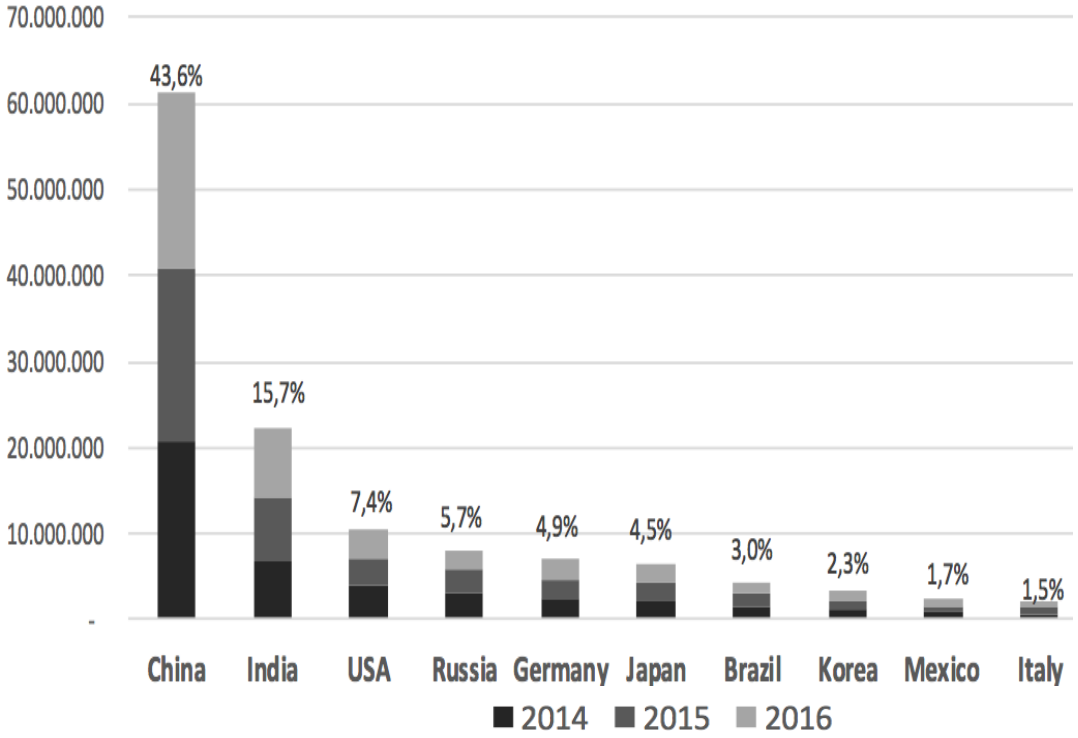
500MPa,2014,weathering steel bridge

钼在铸铁中的应用 Molybdenum in Cast Iron

铸铁类型 Types of cast iron



灰铸铁产量，公吨
Gray iron production per country in metric tons



Data compiled from Census of Worldwide cast production made by MODERN CASTING MAGAZINE in 2015; and 2017，2016

钼在铸铁中的应用 Molybdenum in Cast Iron

铸造行业是钼应用的巨大市场Castings (foundries) represent a significant market for Moly application.

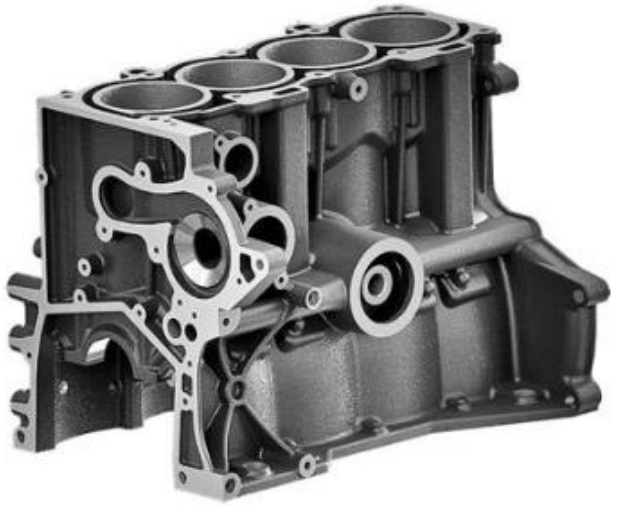
- ✓ 越来越多的铸造行业致力于改善产品性能，尤其是汽车零部件 Increasing requests from the casting industry for better performance especially in automotive parts .
- ✓ 典型的优化标准是强度、韧性、热导率、耐磨性。Typical optimization criteria are strength, toughness, thermal conductivity, wear resistance.

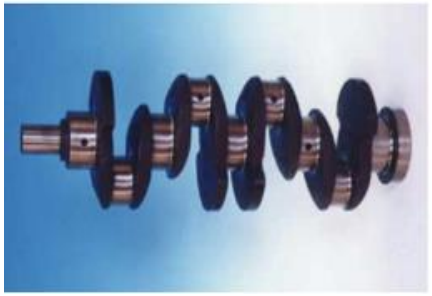
上海大学拥有中国铸造研发重点实验室—为项目提供支持 SHU is the key R&D lab in China for casting developments - project to support:

- 开发强度更高、导热性好的灰铸铁Development of grey iron with higher strength and good thermal conductivity.
- 研究优化钼的作用 Moly to be investigated and optimized in this respect.
- 以国内生产高附加值产品为目标Integration within targeting domestic production of higher value-added products.
- 2018年秋季，IMOA启动了钼合金灰铸铁开发项目In autumn 2018 IMOA started a project to support development of Moly alloyed grey cast iron

中小型灰铸铁产品

Grey Iron medium and small size applications



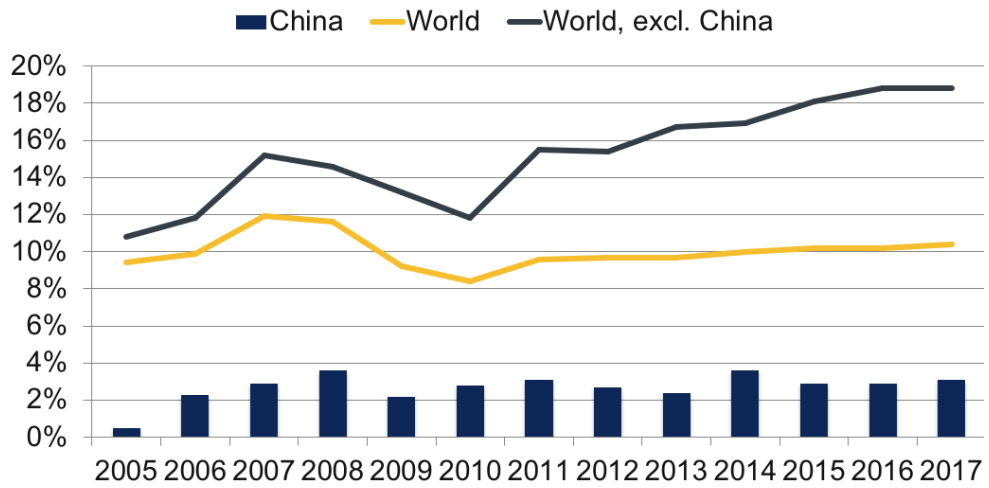


CAST项目：钼合金化对HT350灰铸铁组织和性能影响的研究 The CAST project: “Investigation on the Influence of Molybdenum Alloying on Microstructure and Properties of HT350 Gray Cast Iron”

- 灰口铸铁的成本大大低于球墨铸铁The cost of grey cast iron is substantially lower than that of nodular iron
- 钼在冶金机理中起着重要作用。目标值：拉伸强度300-500 MPa，导热率40-50W/m.K。 Molybdenum plays an important role in the underlying metallurgical mechanisms. Targets should be a tensile strength of in the range 300-500 MPa and heat conductivity of 40-50 W/m.K.
- 项目目标: 开发强度高于低等级球墨铸铁的灰铸铁，同时具有很好的导热性Aim of the project is to develop gray iron with increased strength, comparable to the lower level of nodular iron, and simultaneously very good heat conductivity.
- 今年秋季完成首批试验First results to be *presented* Autumn this year

不锈钢

	1000 tons tot	Stainless Series 200	300	400	Duplex
2016	24610	29.6%	50.0%	19.7%	0.36%
2017	25774	27.9%	52.0%	19.7%	0.40%
2018	26707	30.6%	49.3%	19.7%	0.06%



	SS Moly grades %	1000 Tons
2016	2.3%	566
2017	3.0%	773
2018	2.7%	721

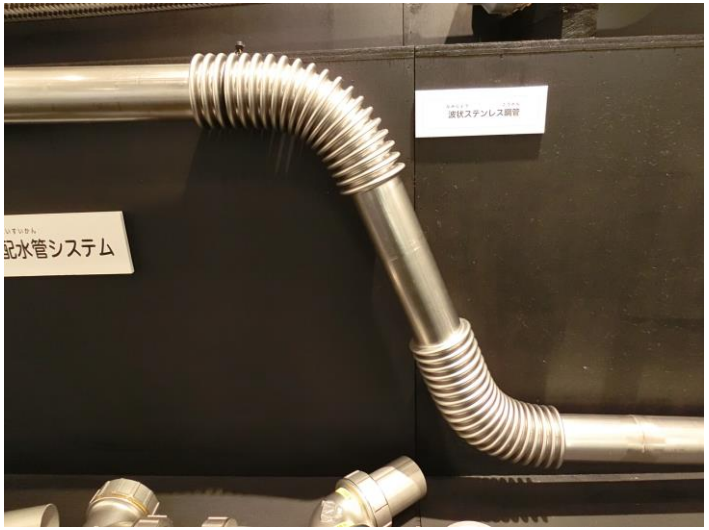
Source CSSC; IMOA

供水管道先进防漏措施

Water Distribution, Advanced leak management

解决方案: 316不锈钢波纹管

Solution: Corrugated 316L SS pipe



烟气脱硫 FGD - Flue Gas Desulphurisation

上海电力学院
SHANGHAI UNIVERSITY OF ELECTRIC POWER

不锈钢分会委托上海电力大学调查中国燃煤电厂湿烟气脱硫和腐蚀情况，2020年初完成。 A “Survey of wet FGD and corrosion of coal fired power plants in China” has been finalized with SUEP (Shanghai University of Electric Power) via CSSC to be completed early 2020.

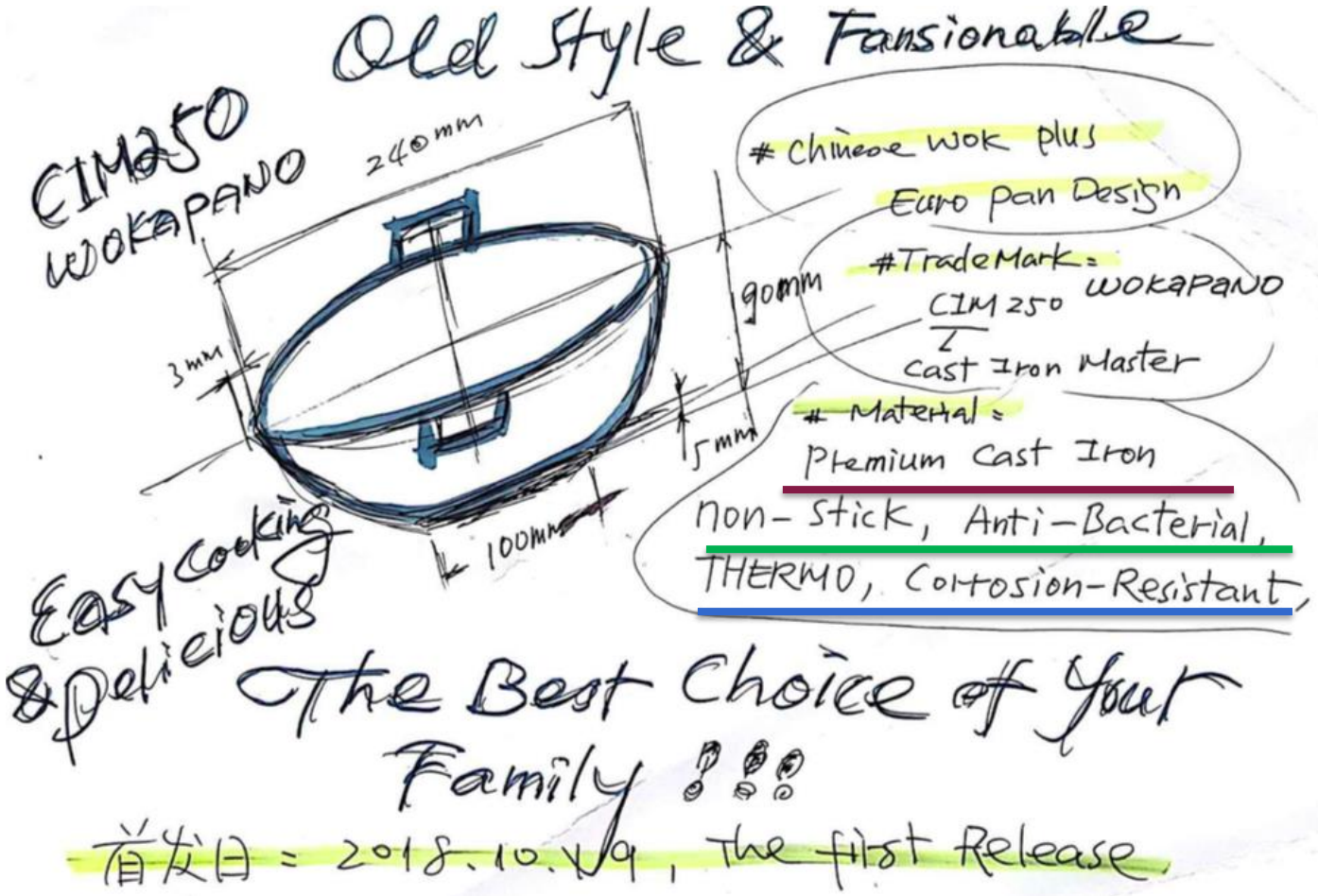
Grade	UNS No.	EN No.	Cr	Mo	Ni	N	PREN
904L	N08904	1.4539	19-23	4-5	23-28		34-36
317LMN	S31726	1.4439	17-20	4-5	13.5-17.5	0.1-0.2	37-38
6% Mo	*		19-22	6-7	17.5-26	0.15-0.25	43-45
Alloy 31	N08031	1.4562	26-28	6-7	30-32	0.15-0.25	51-52
7% Mo	S32654	1.4652	24-26	7-8	21-23	0.45-0.55	56-57

A Mo application for the consumer market

厚壁铸铁中华锅：灰铁钼合金化的实践
Better cooking with better Wok: a practice of gray cast iron alloying with Mo

廉心桐　董瀚，上海大学
LIAN Xintong & DONG Han, Shanghai University
November 29, 2018

一口好锅对一个家庭重要吗?



一口好锅对一个家庭重要吗?

人的寿命长

银微合金化抗菌

优选铸造生铁

锅的寿命长

稀土微合金化耐蚀

耐热合金化材料

钼在铸铁中的应用　Molybdenum in Cast Iron

钼在日用消费品领域的应用

A Mo application for the consumer market

钼具有独特和非常强大的冶金效应，还有更多的功效待开发。没有中国钼行业的支持，国际钼协会所拥有的智库、数据库和技术专长如同无弓之箭。

Moly provides a unique and very powerful portfolio of metallurgical effects. Additional beneficial effects still have to be discovered. IMOA's intelligence, data base and competences without the support of the Chinese Moly industry are *arrows without their bow*.

钼和含钼材料的世界

微信号: IMOA-Mo

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