BAOSTEEL 宝钢股份 | 构 筑 共 享 价 值

Challenges of AHSS（≥1GPa） Production and Application

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Baosteel R&D Center, Shanghai, China

SKL of Development and Application Technology of Automotive Steels

Aug. 14, 2014

Contents:

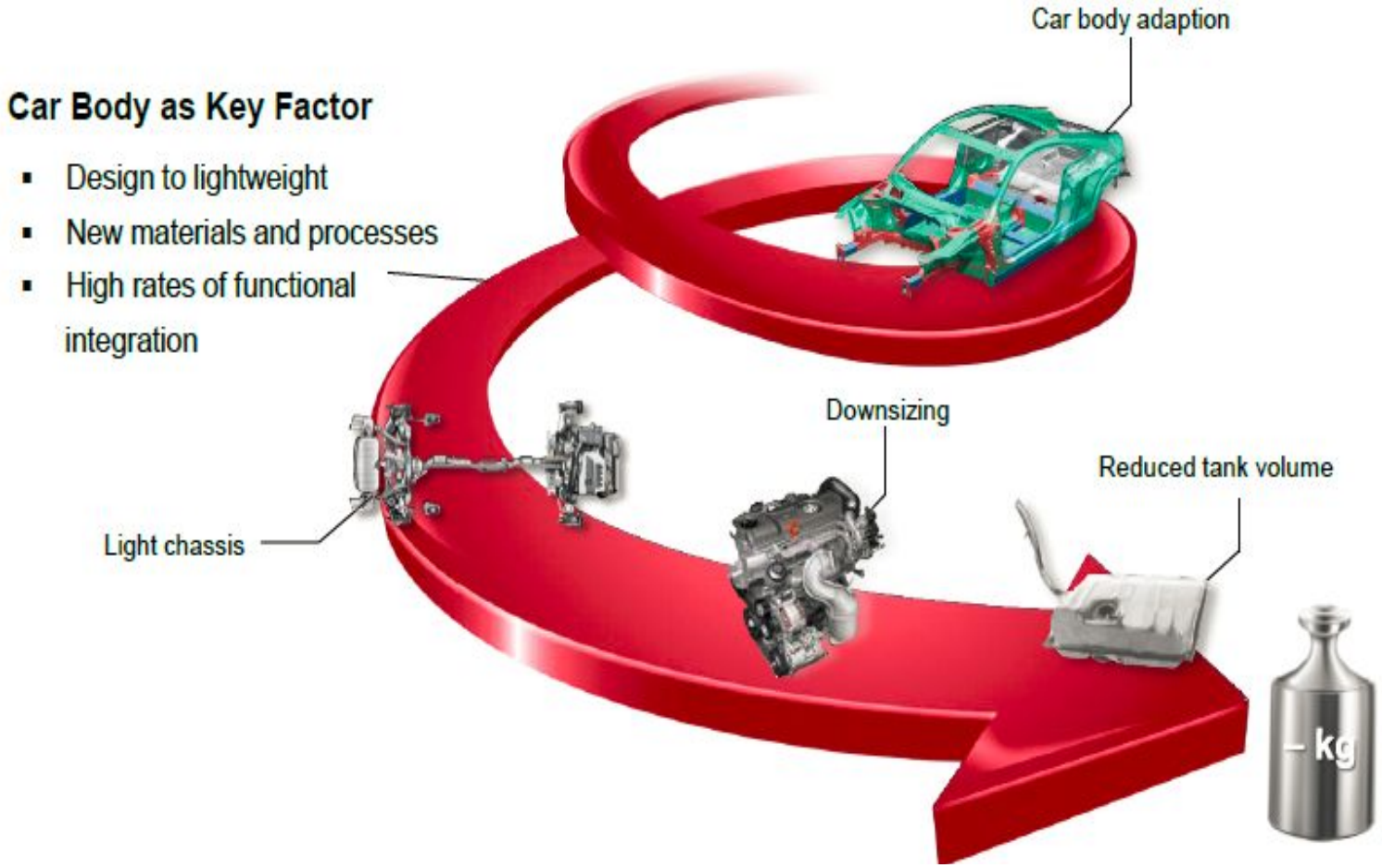
1. Background

2. Challenges of AHSS production

3. Challenges of AHSS application

4. Conclusion remarks

● *Automotive "lightweighting" is driving research worldwide*



Dr. M. Alsmann, Dr. M. Goede, Dr. S. Kulp und M. Lalla (Volkswagen AG); J. Patak und F. Russ (Audi AG)

- ***Competition is fierce !***

Ford Reveals New Aluminum F-150 Truck

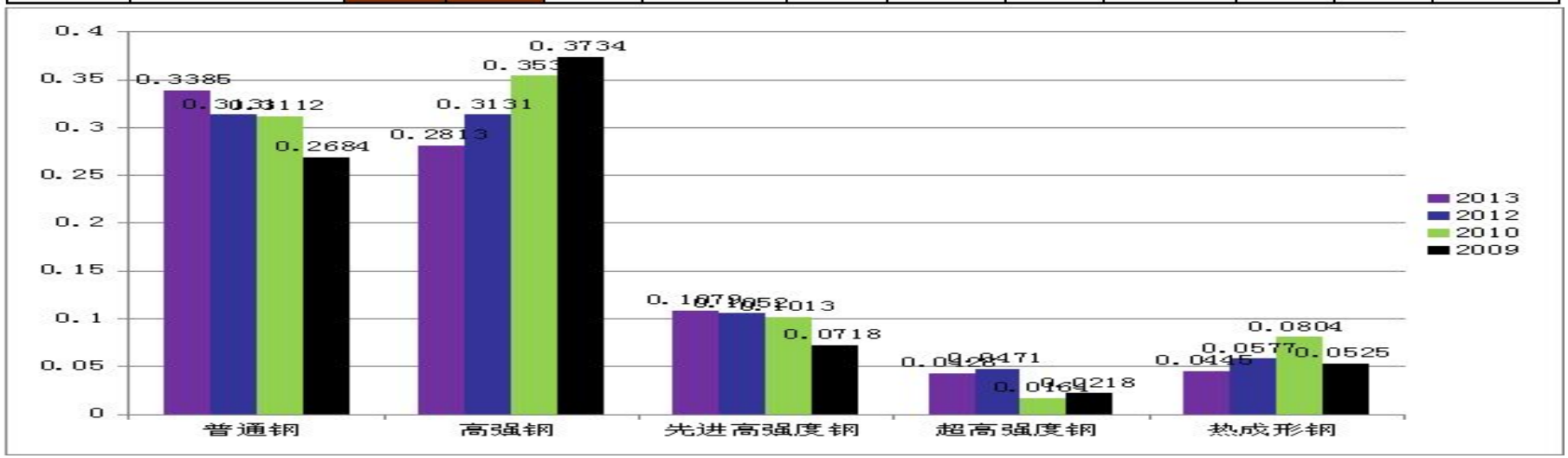
AP | by DEE-ANN DURBIN and TOM KRISHER

Posted: 01/13/2014 12:04 am EST | Updated: 01/23/2014 6:56 pm EST

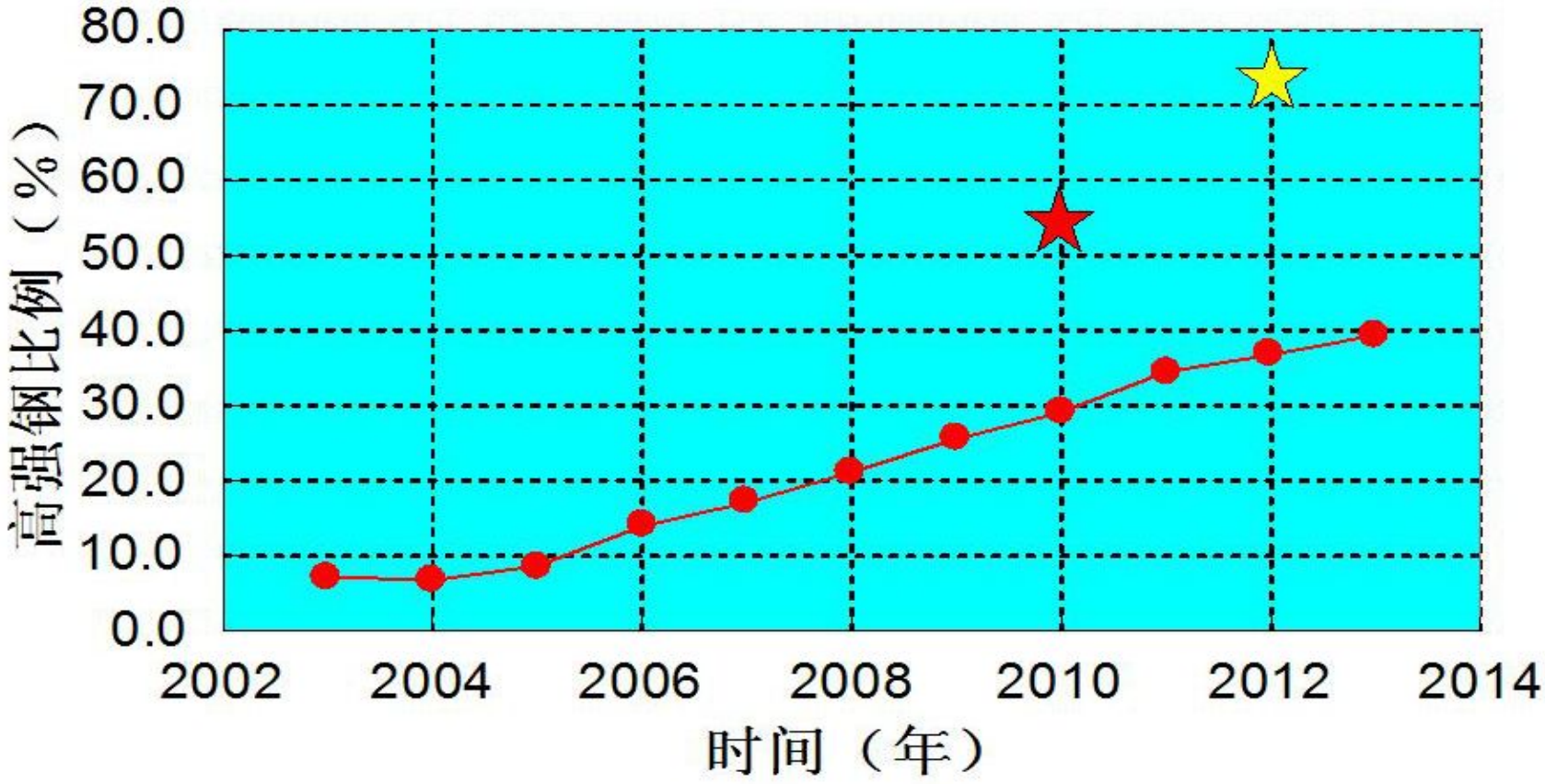
● AHSS is an affordable solution

2013年欧洲车身会议车型参数一览表

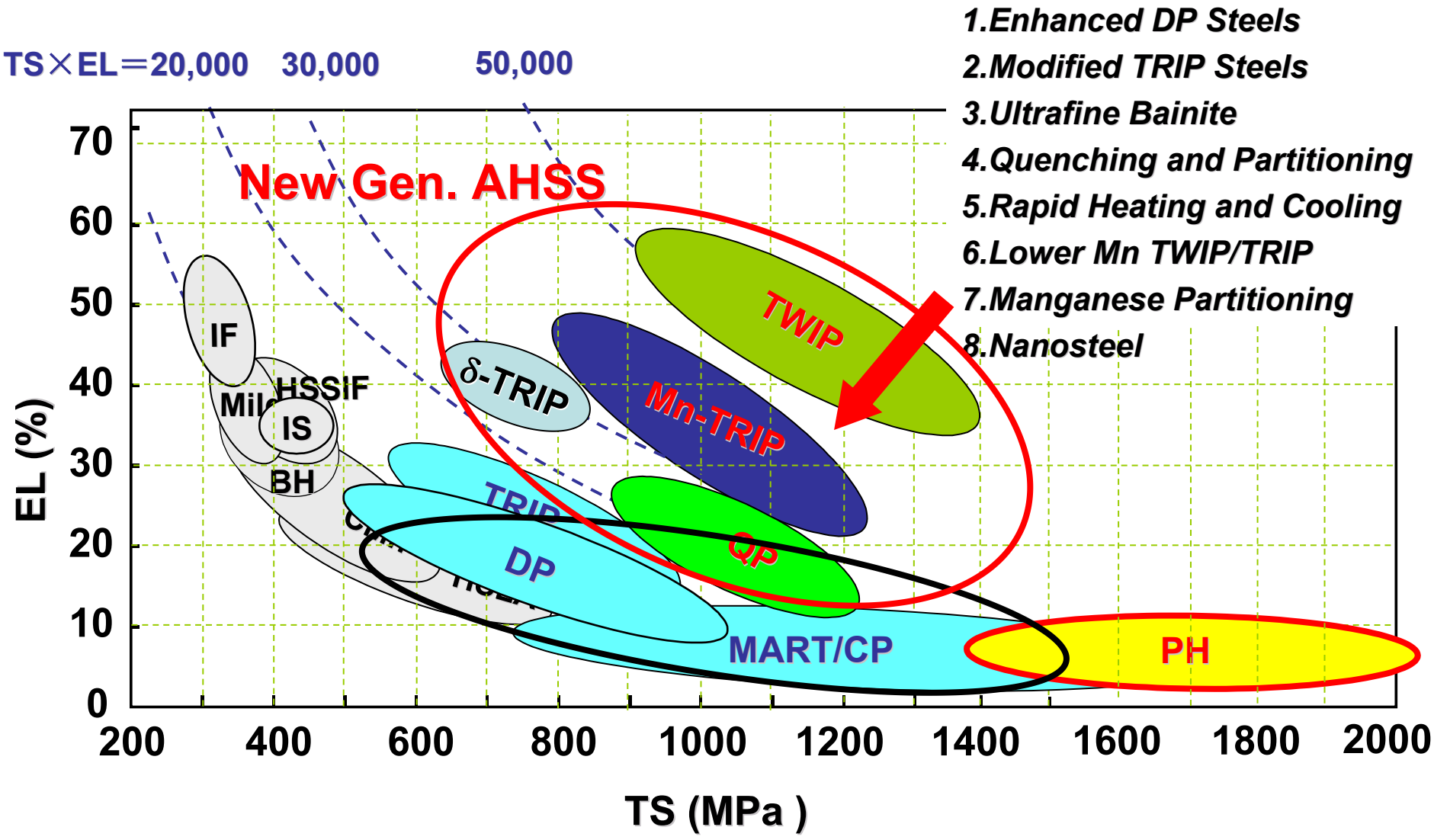
基本情况	公司	Benz	BMW	Lexus	Range Rover	Infiniti	Alfa Romeo	Honda	Lamborghini	Opel	Renault	Ford
	车型	S-Class	i3	IS	Sport	Q50	4C	Fit	Aventador	Cascada	Captur	Transit
钢种比例	普通钢	14.00%	7.29%	49.40%		44.70%	2.00%	54.40%		31.90%	41.70%	59.23%
	高强钢	24.50%		28.20%	4.00%	21.30%		26.50%		52.10%	41.60%	26.84%
	先进高强钢	10.50%		15.40%		22.80%	4.00%	11.00%		10.40%	6.50%	5.74%
	不锈钢						2.00%					
	超高强钢	7.50%		0.60%		5.90%					3.10%	
	PHS	8.00%		4.00%	1.00%	2.20%		6.90%		1.60%	3.70%	8.19%
铝合金比例	7系铝合金板							1.20%		0.70%		
	6系铝合金板	2.50%	10.66%	2.40%	37.00%	2.10%	3.00%			3.30%		
	5系铝合金板	18.00%	0.76%		37.00%	0.40%						
	铝合金挤压	5.50%	3.89%		6.00%	0.50%	26.00%				1.70%	
	铸造铝合金	6.50%	3.89%		15.00%		7.00%					
镁合金比例	镁合金											
非金属材料	纤维增强塑料	0.50%	49.41%				30.00%					
	硬质塑料						25.00%				1.60%	
	热塑塑料	2.50%	10.05%									



● *HSS esp. AHSS ↑*

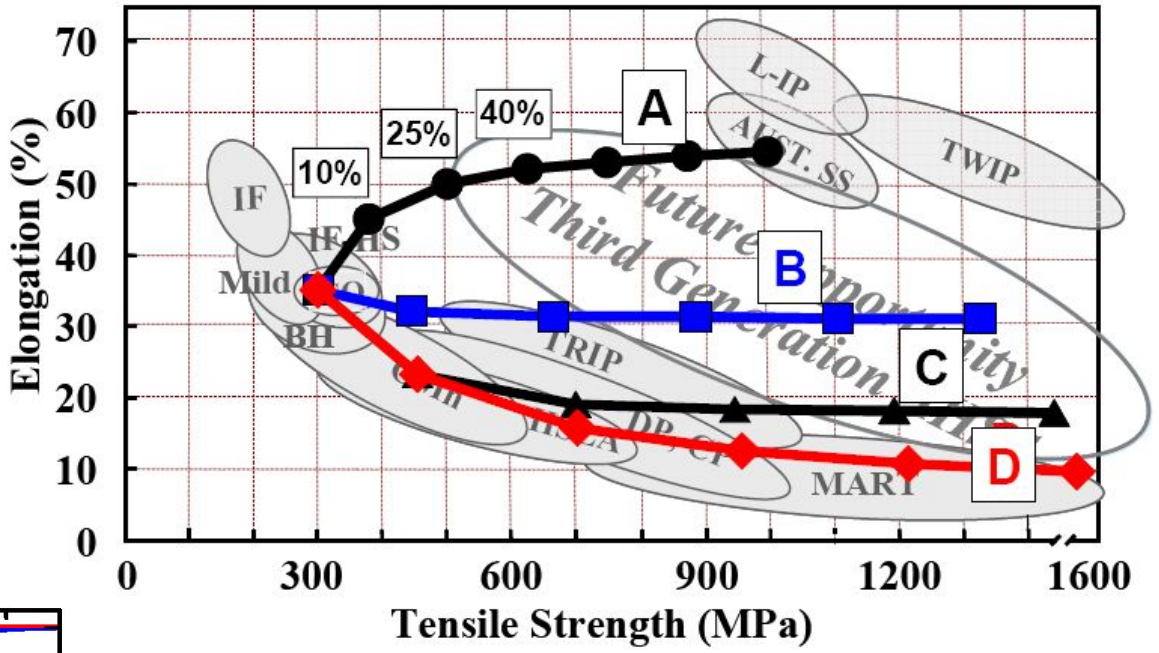

80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
高强钢比例（%）
2002
2004
2006
2008
2010
2012
2014
时间（年）

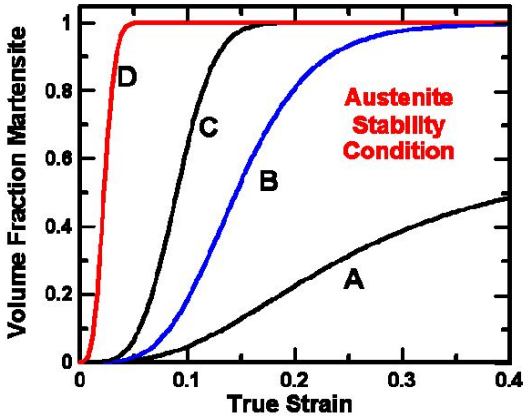
● 3rd Gen. AHSS: different route



1.Enhanced DP Steels
2.Modified TRIP Steels
3.Ultrafine Bainite
4.Quenching and Partitioning
5.Rapid Heating and Cooling
6.Lower Mn TWIP/TRIP
7.Manganese Partitioning
8.Nanosteel

- ***Control of austenite stability offers an opportunity…***

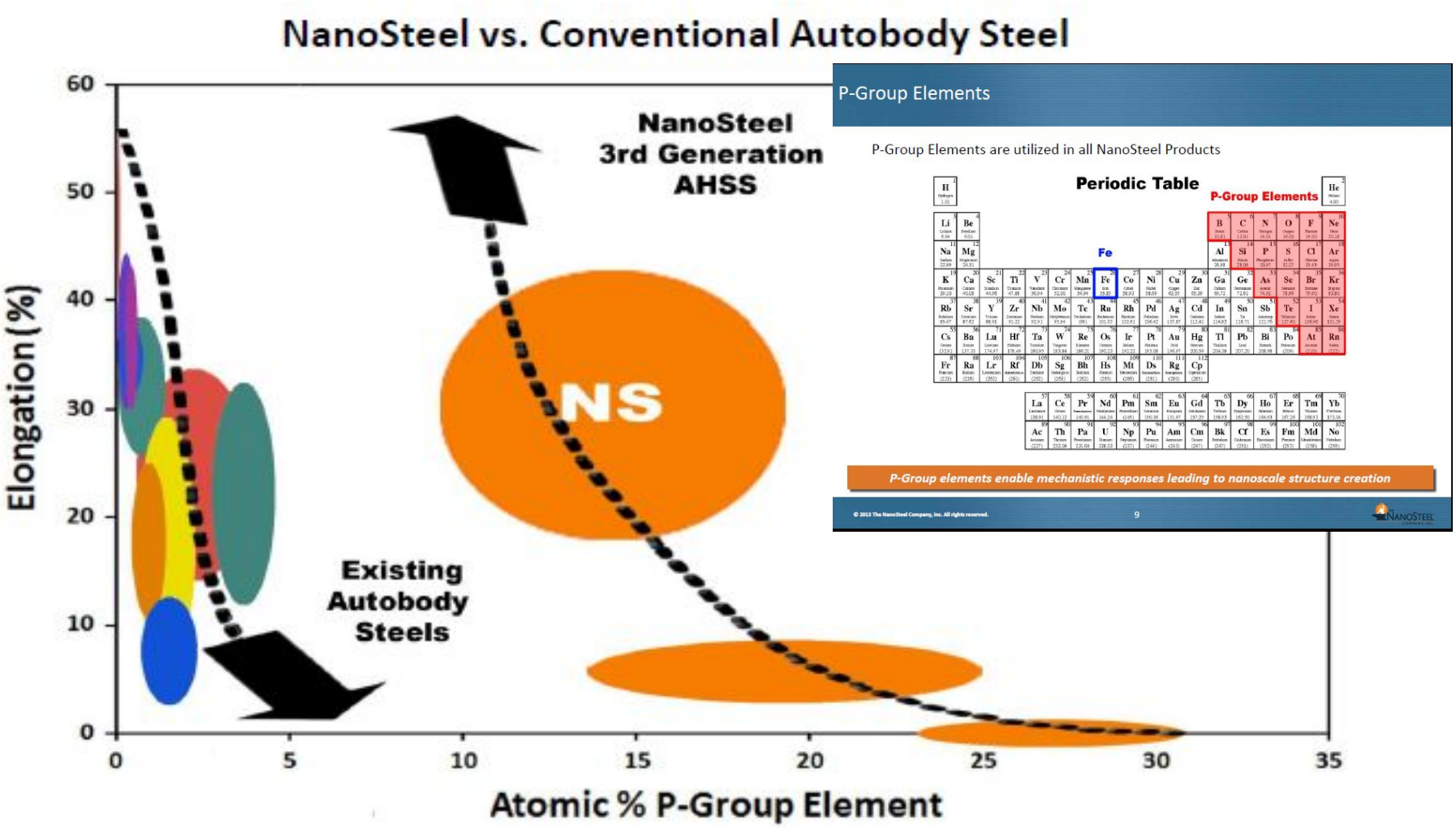




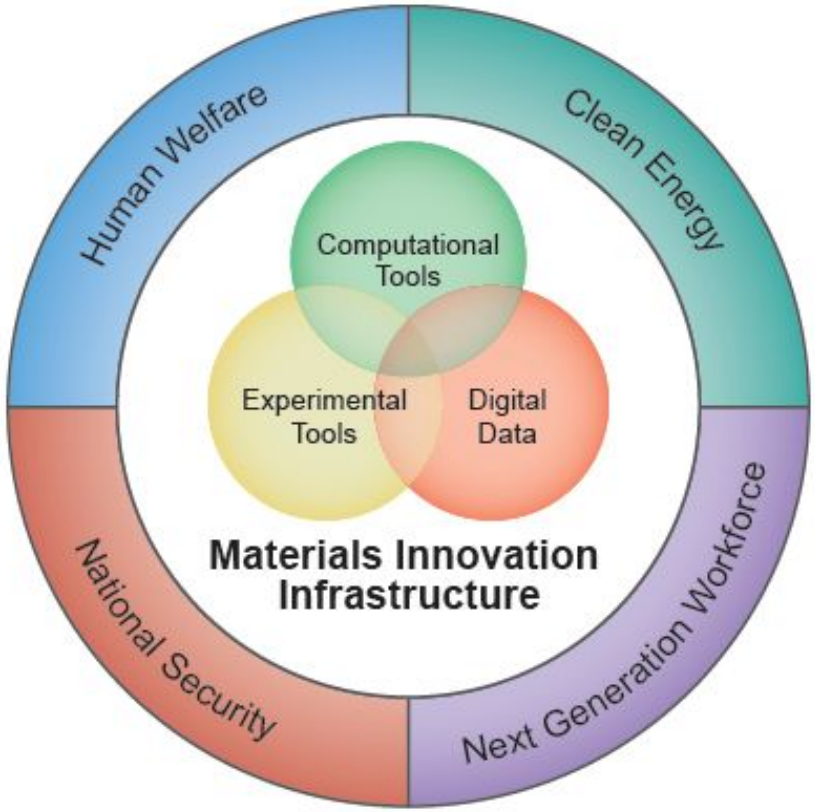
α/γ mixtures

Matlock/Speer: 2008

● *Other routes---*



Materials Genome Initiative



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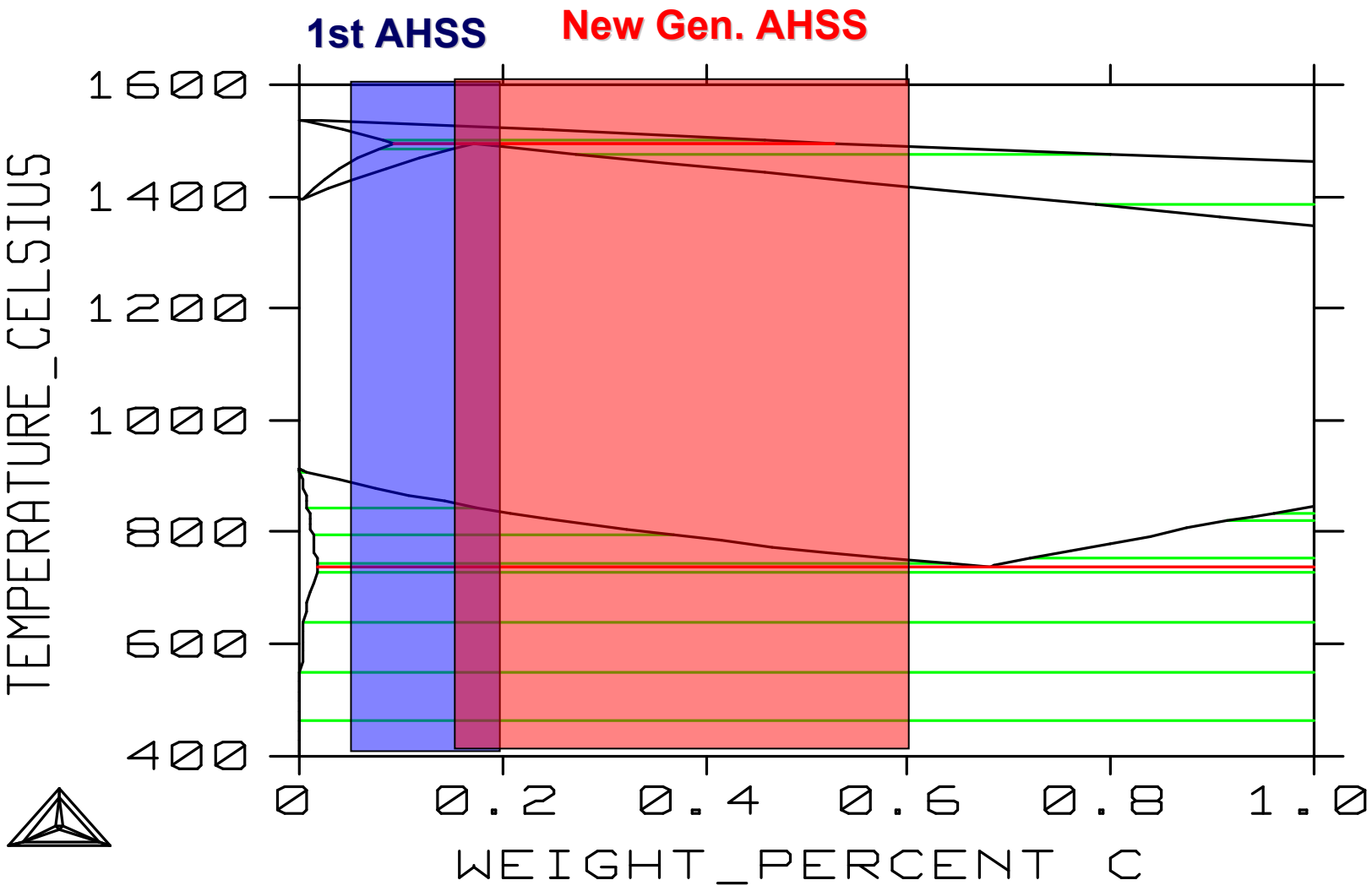
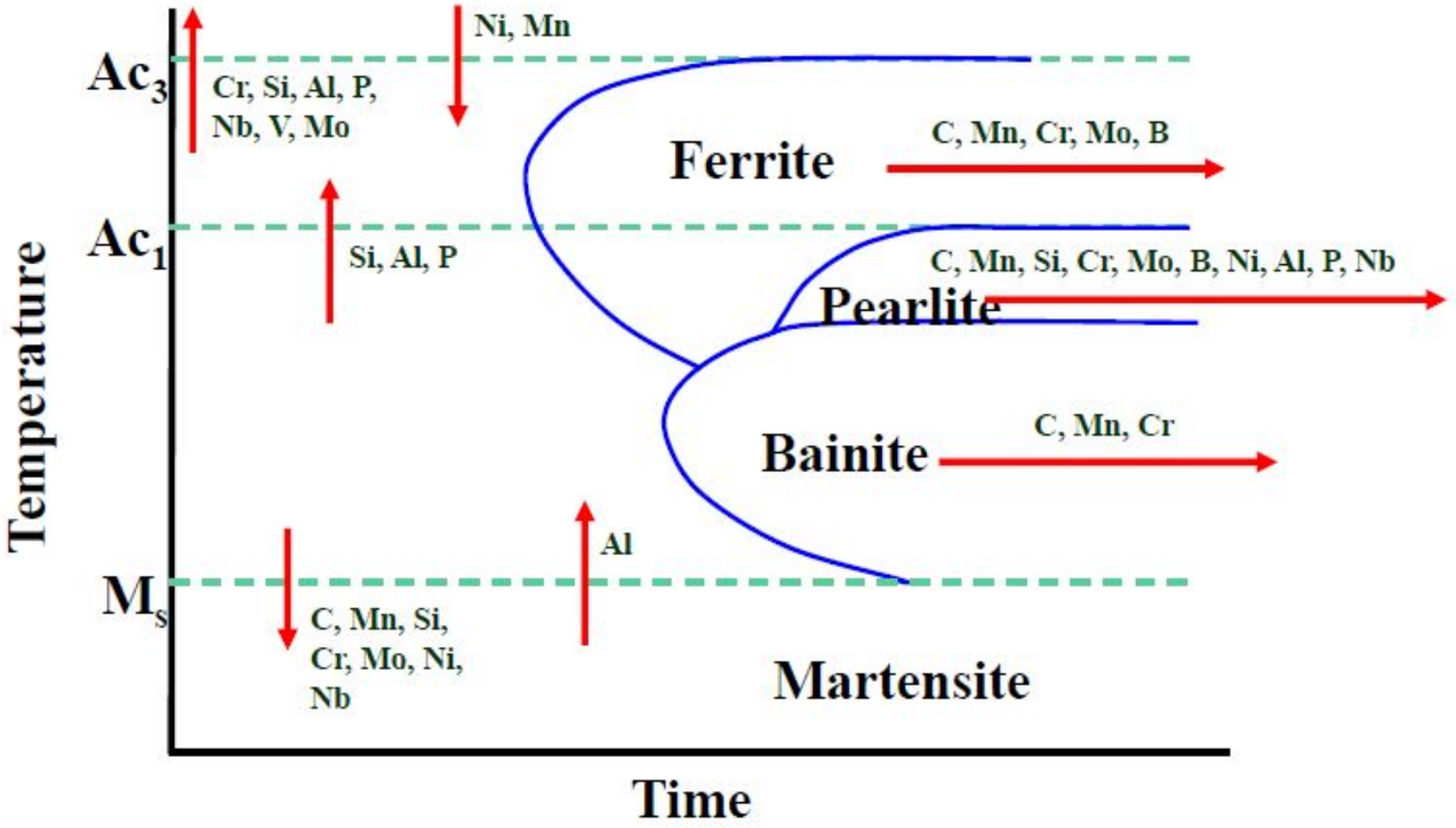
● Composition features of AHSS

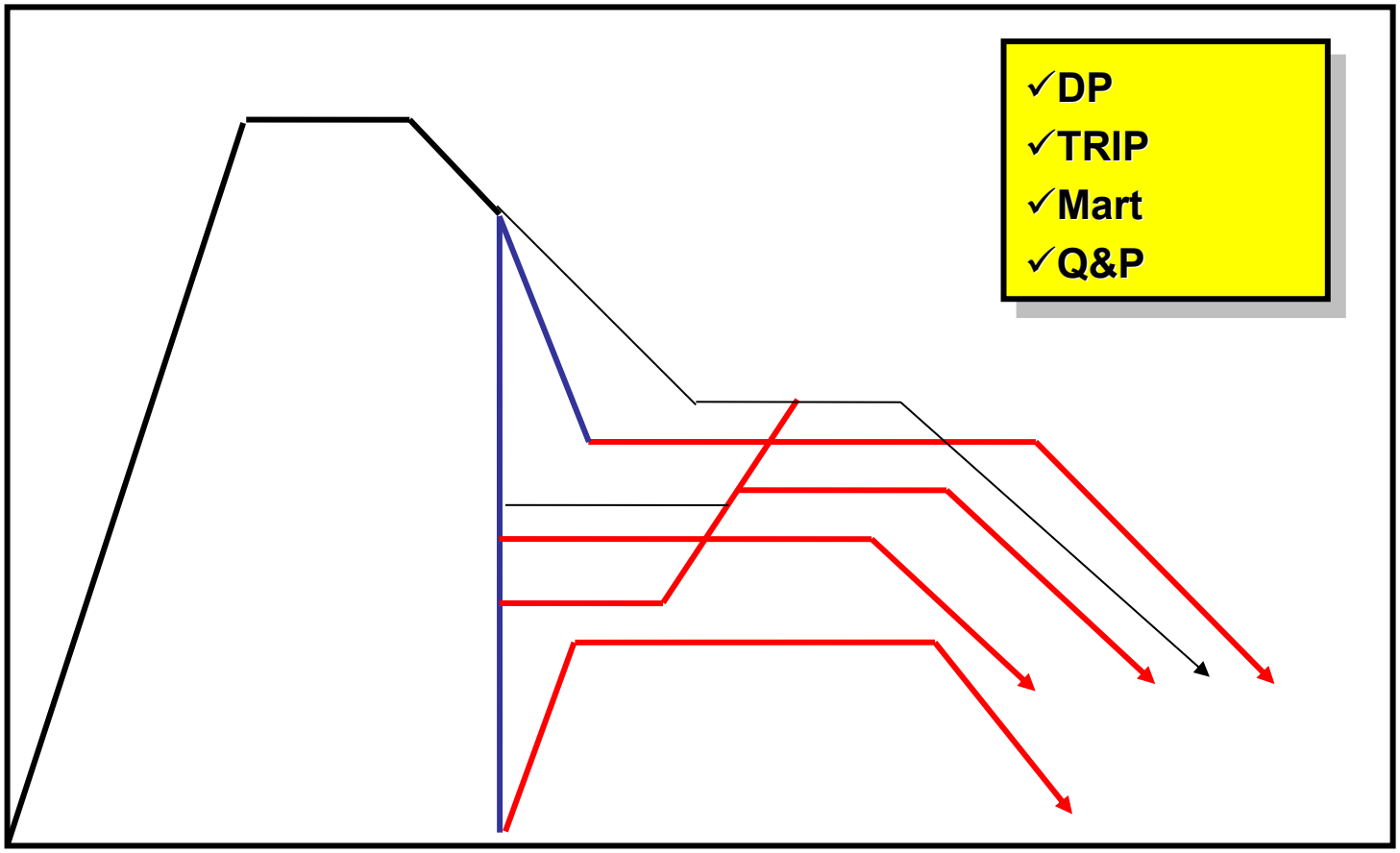


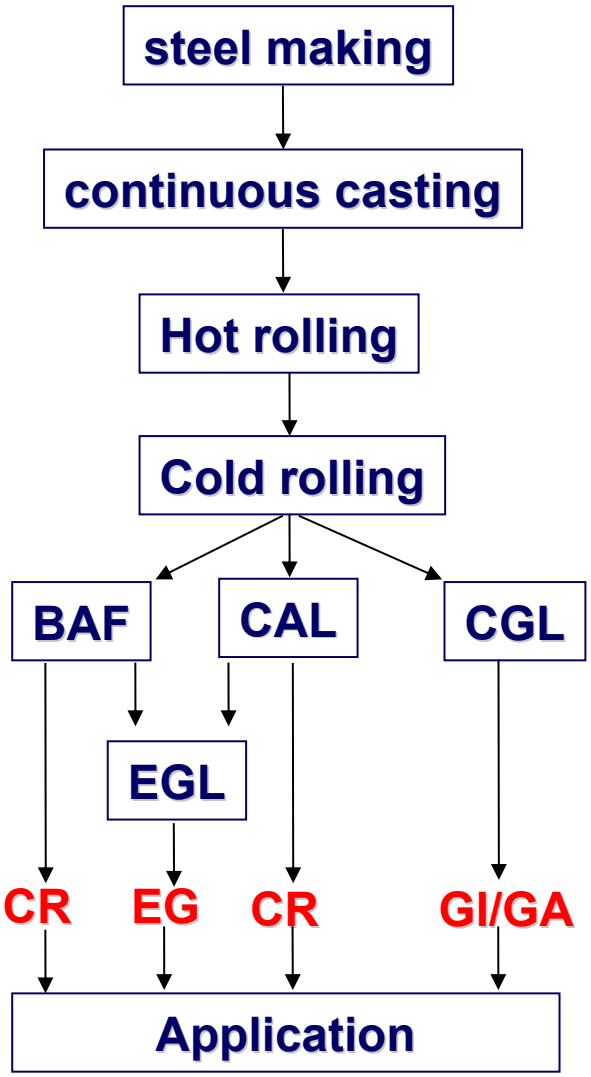
● Composition features of AHSS



H. Hofmann, D. Mattissen and T.W. Schaumann, Steel Res. Int. 80, No. 1, 2009, pp. 22

● Process of AHSS



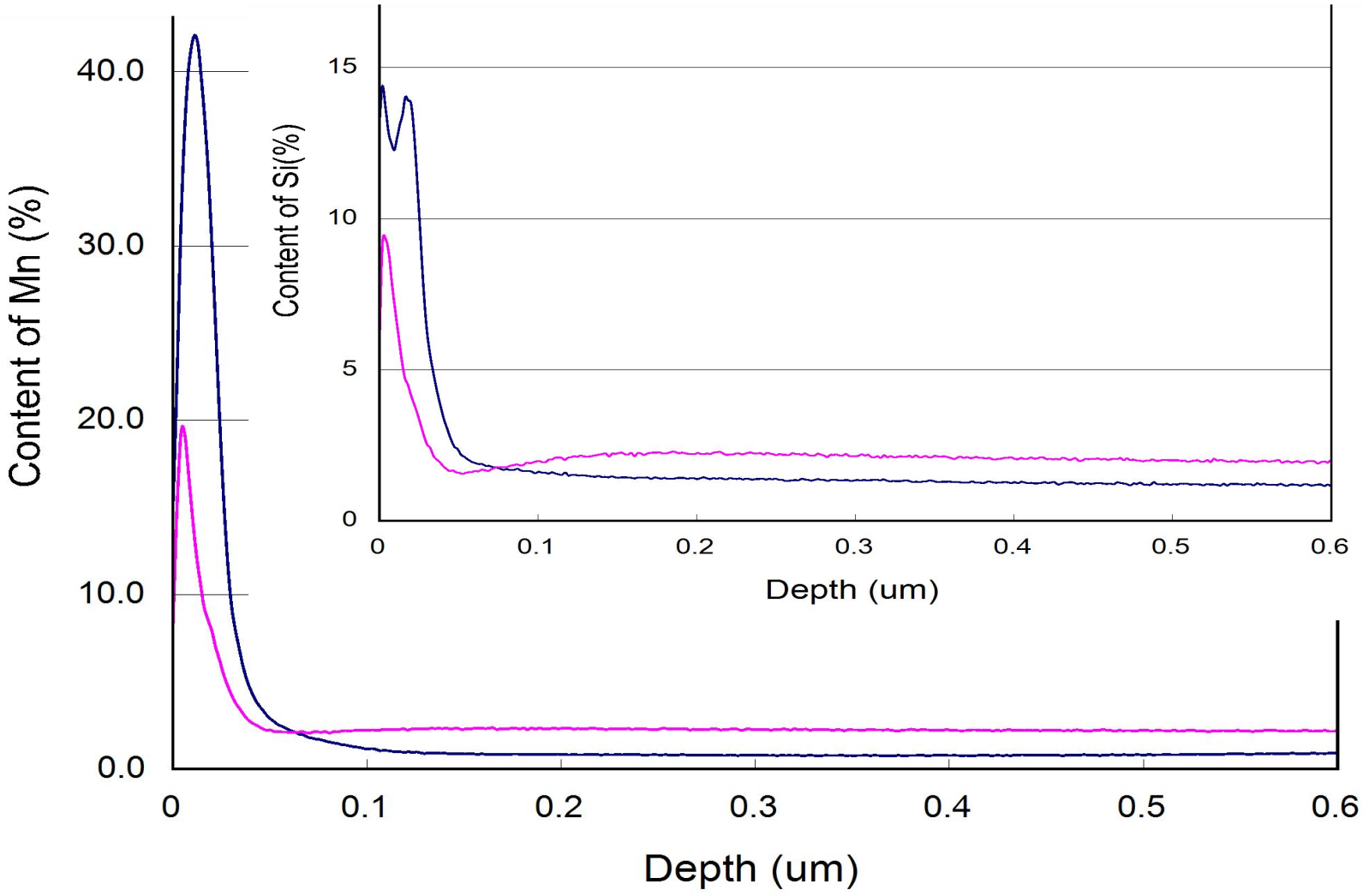


- Cast defect
- Hot rolled defect
- High force
- surface defect
- Sensitive to T
- Property stablity
- Thin gage
- Thickness accuracy
- Sensitive to cuting edge
- Spring back
- Galling
- Welding
- HE
- ...

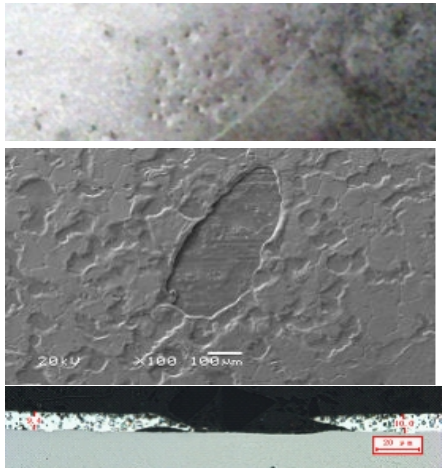
Coatability and surface defects

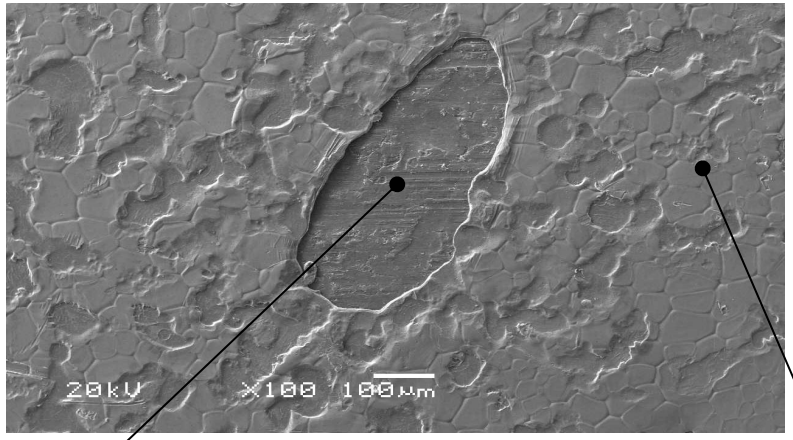
● Coatability and surface defects

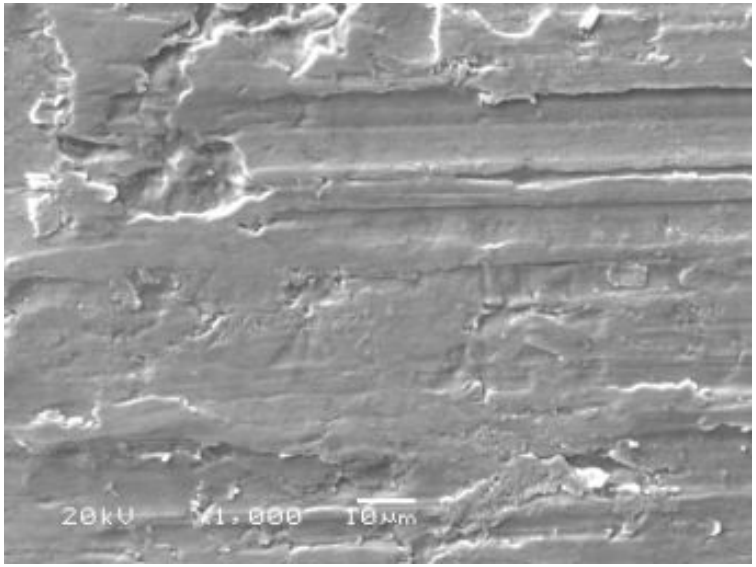
Enrichment of Mn & Si can be reduced by pre-oxide treatment



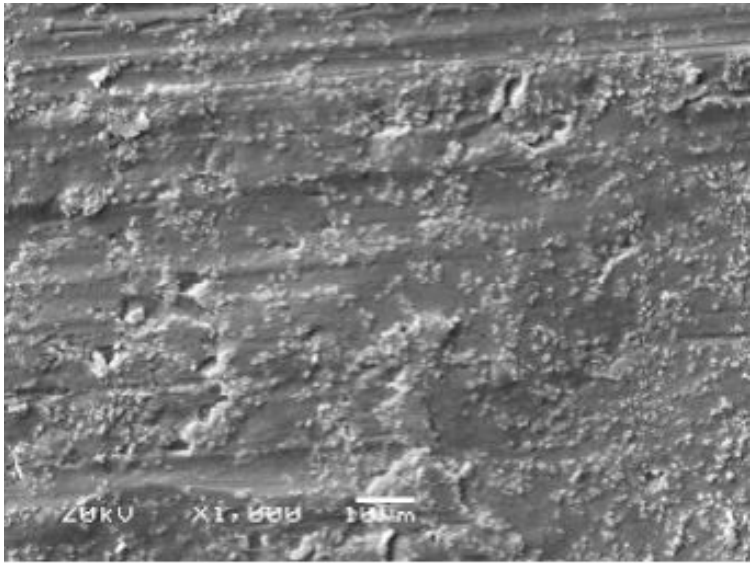
● Coatability and surface defects







No Fe-Al inhibition layer



Fe-Al inhibition layer

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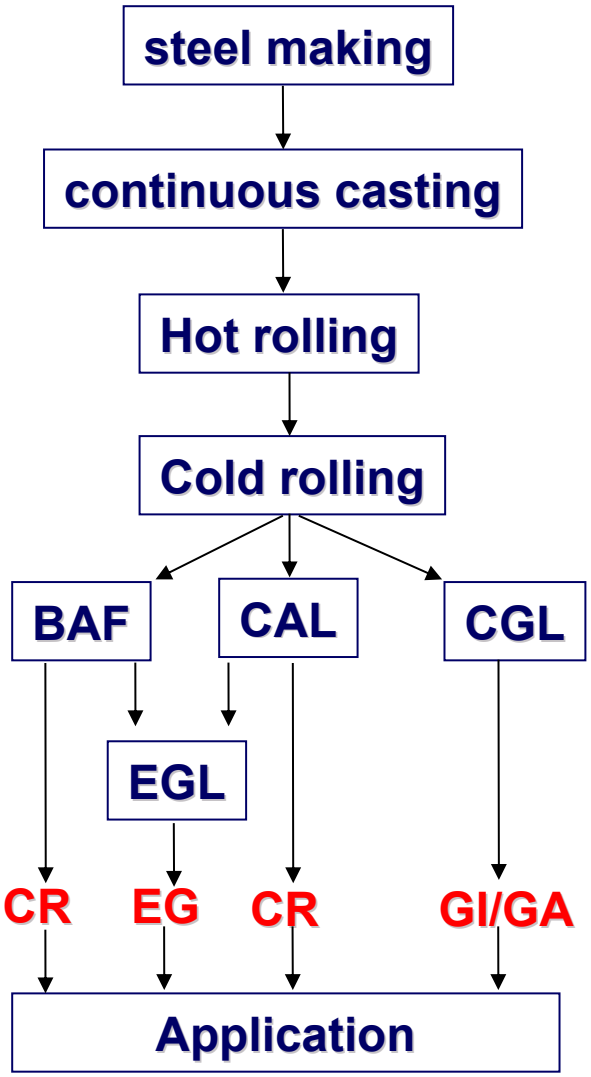

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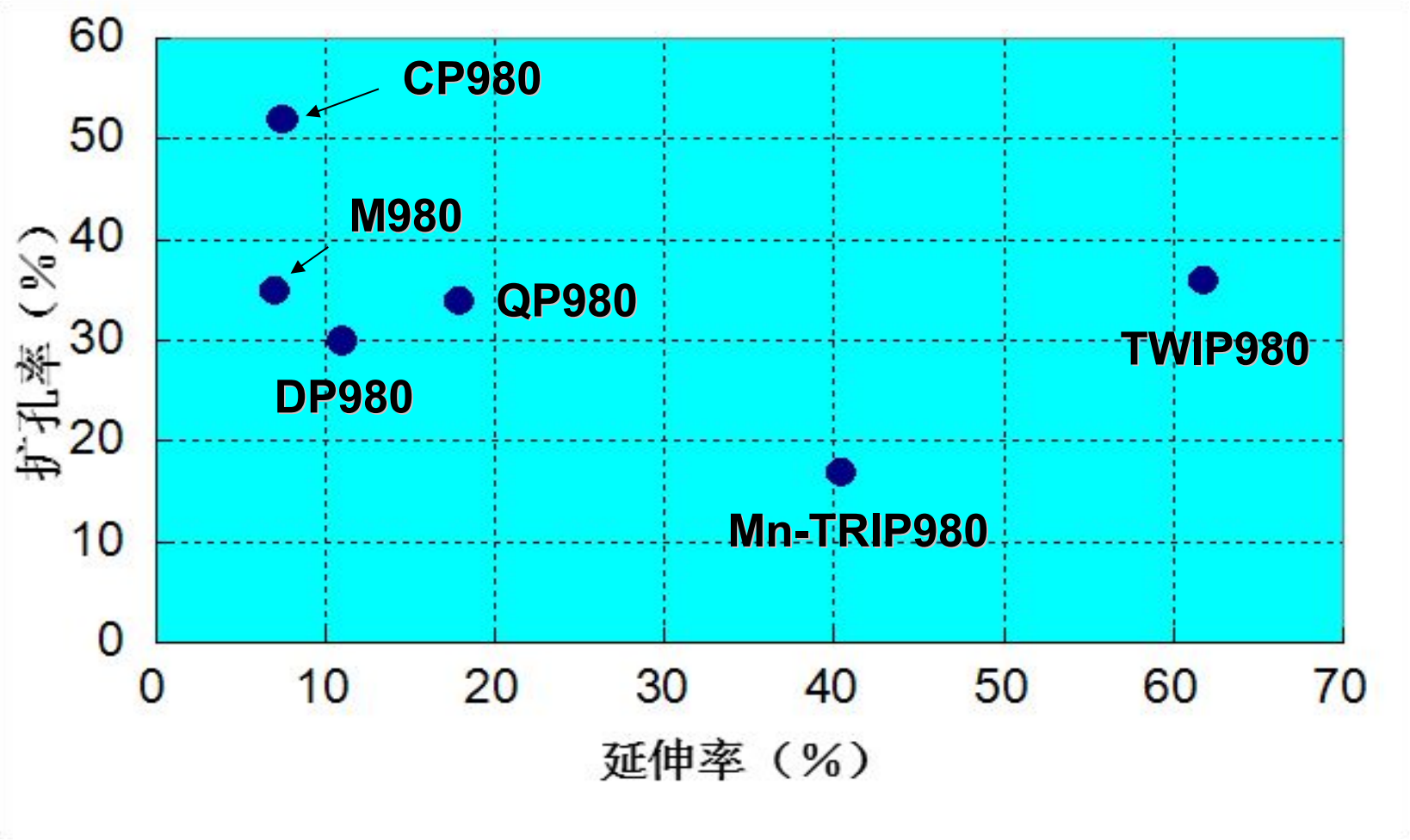
- Welding
- HE
- ...

● *HE or delayed fracture*

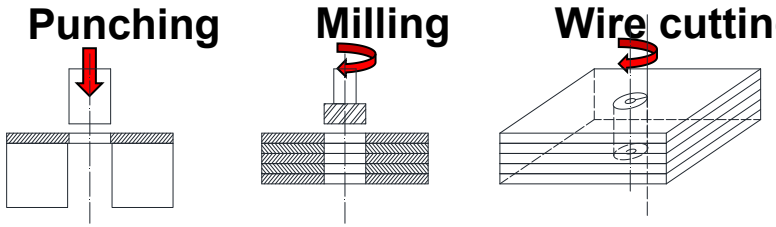
1. Cup test

2. U-test

EL & Hole Expansion

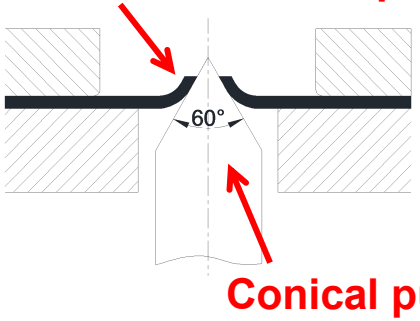


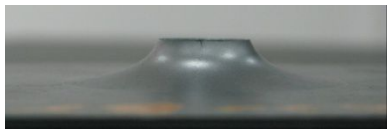
● Hole Expansion Ratio

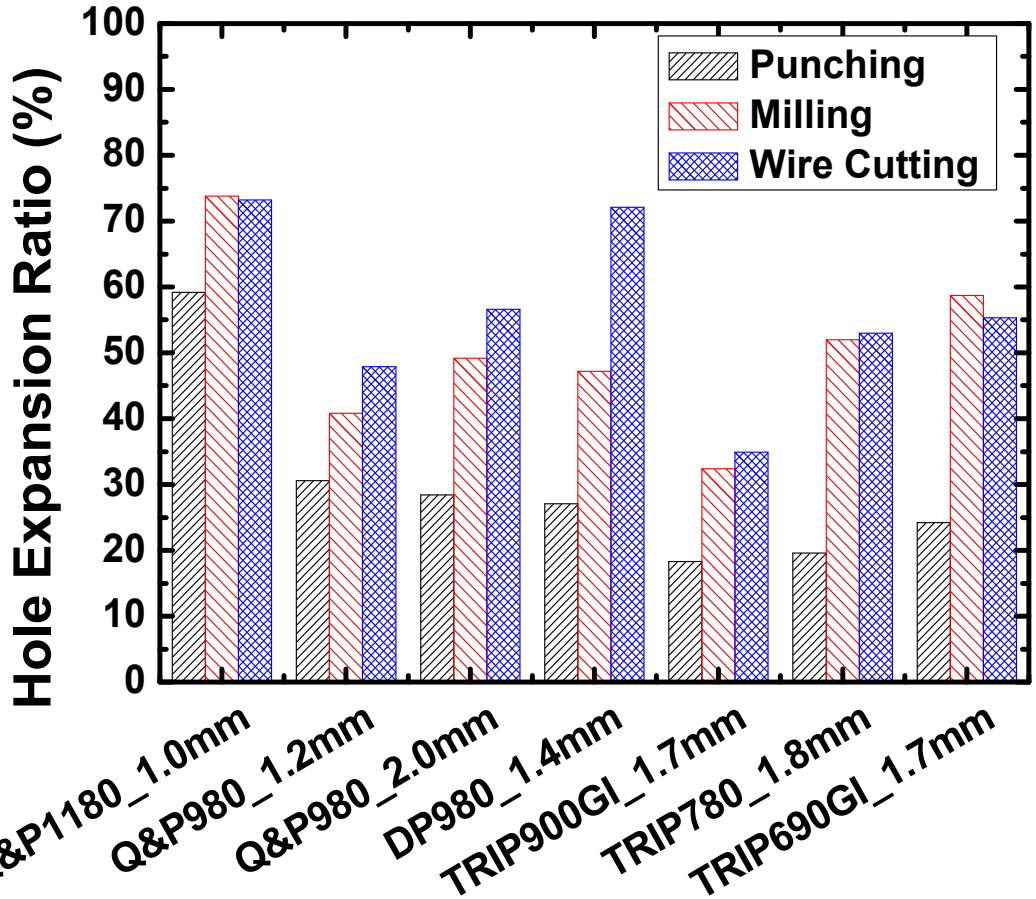


$$HER=(d_f-d_0)/d_0\times 100\%$$

Burrs in the "UP" position







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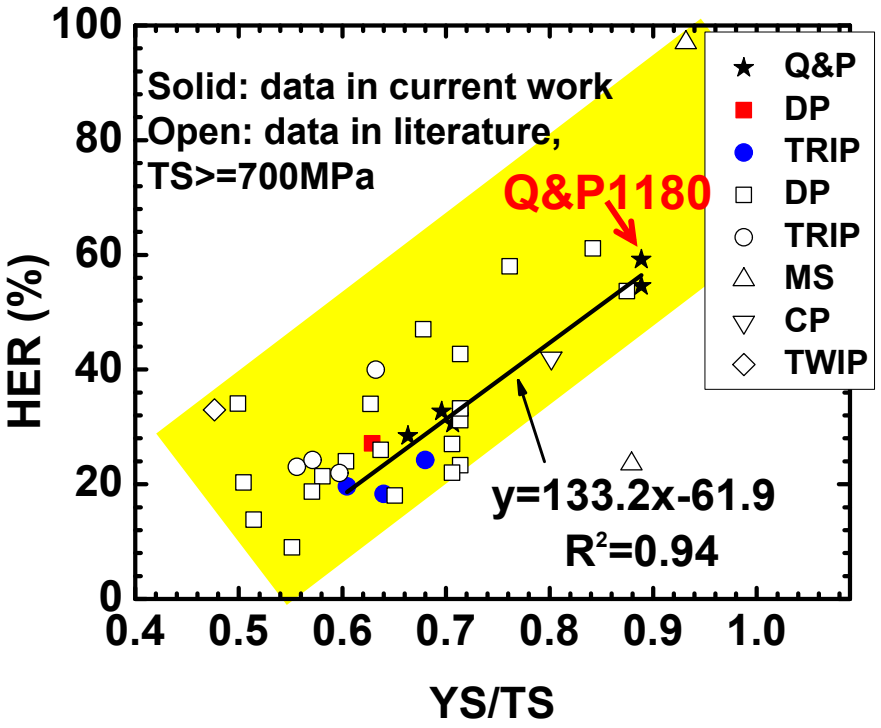
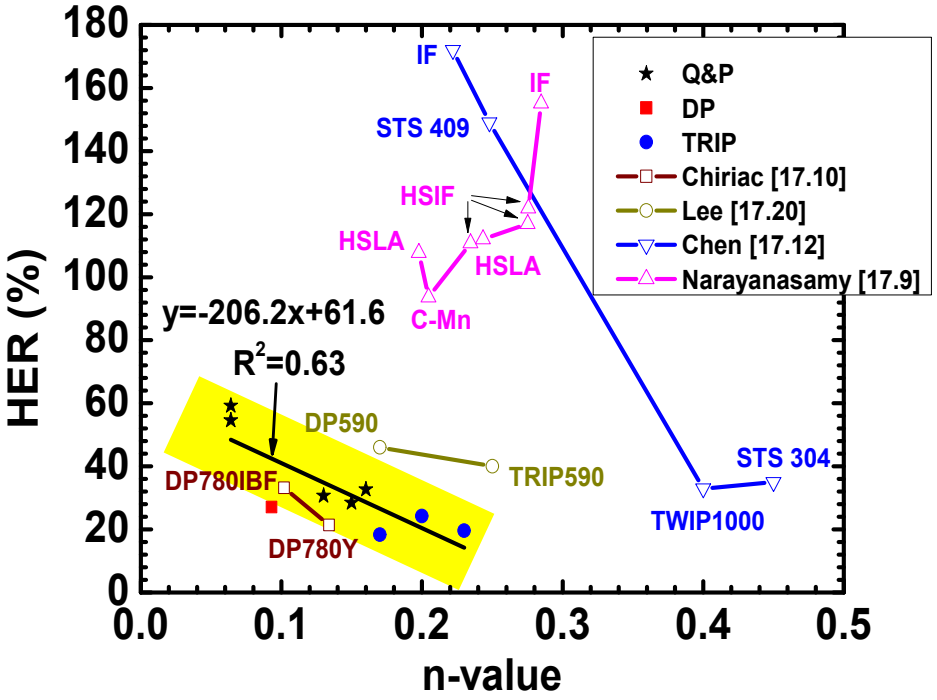
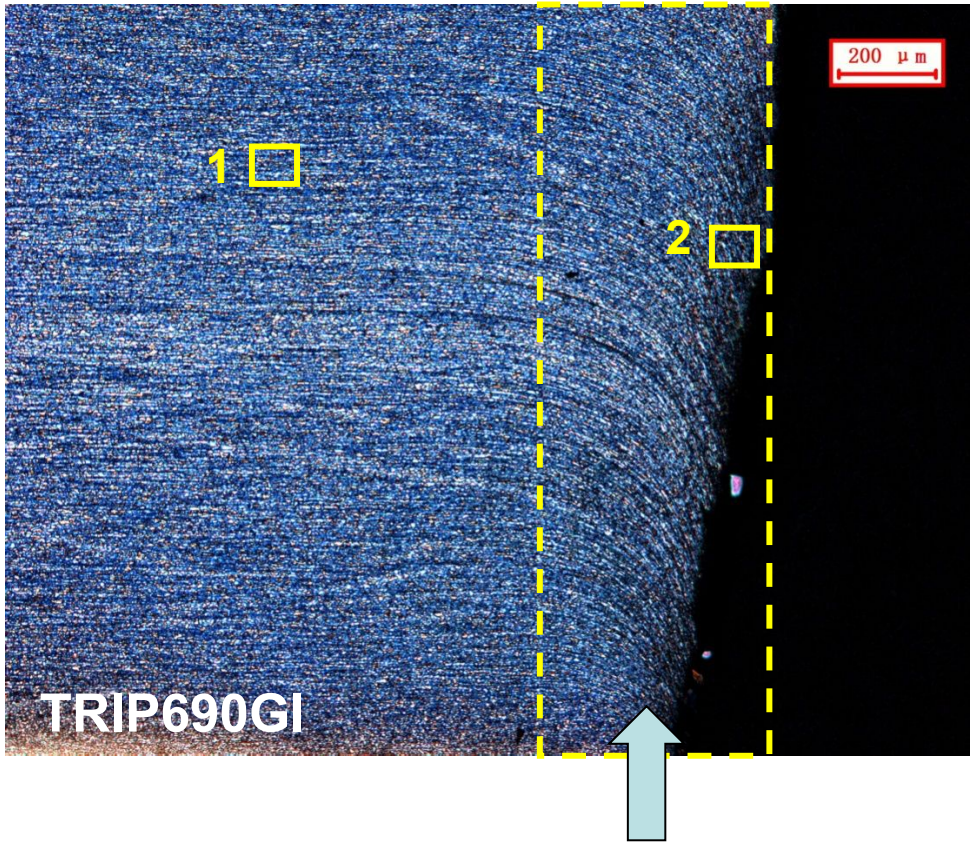
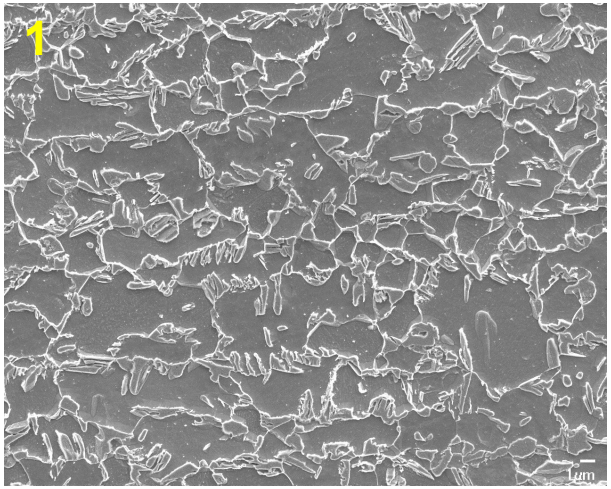
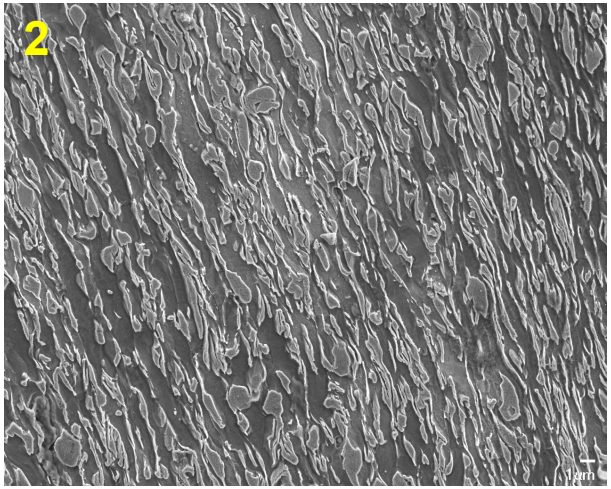




A typical cross-section of punched edge



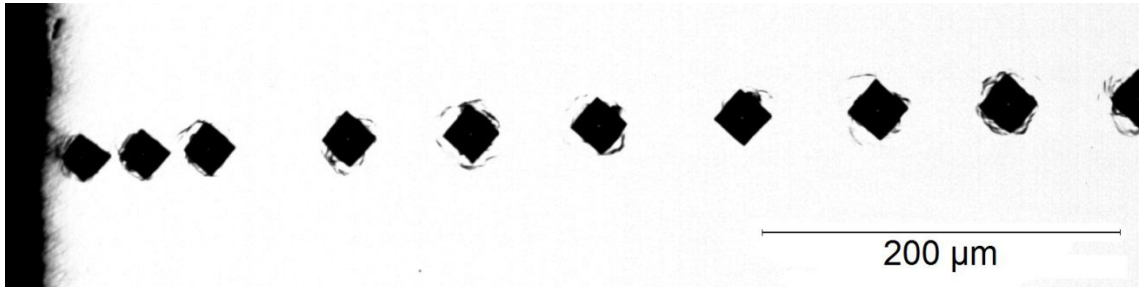


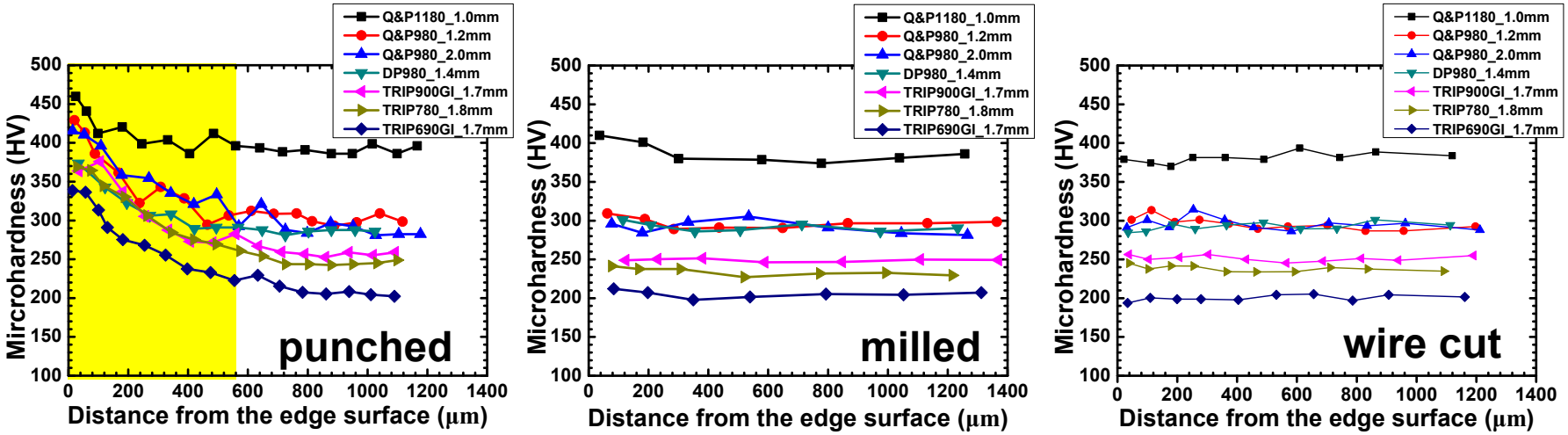


Shear Affected Zone (SAZ)

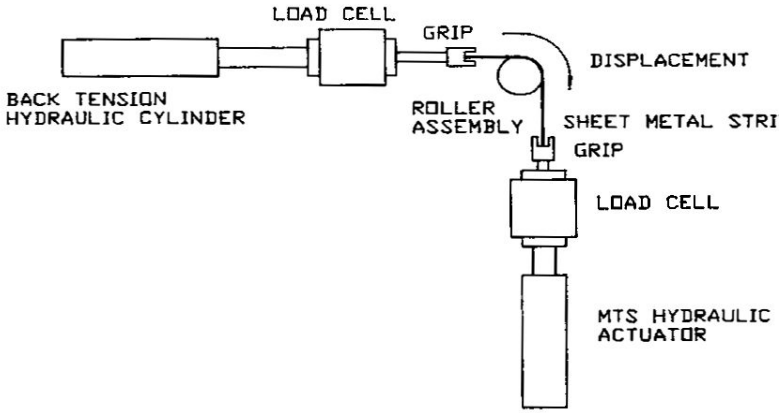
Microhardness profiles at mid-thickness

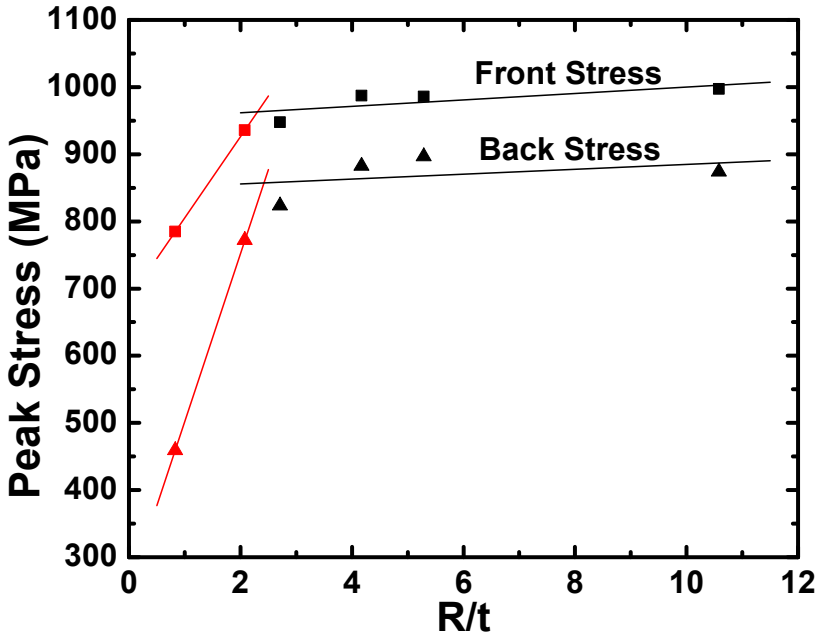
The punching process resulted in a significant hardness increase at the edge

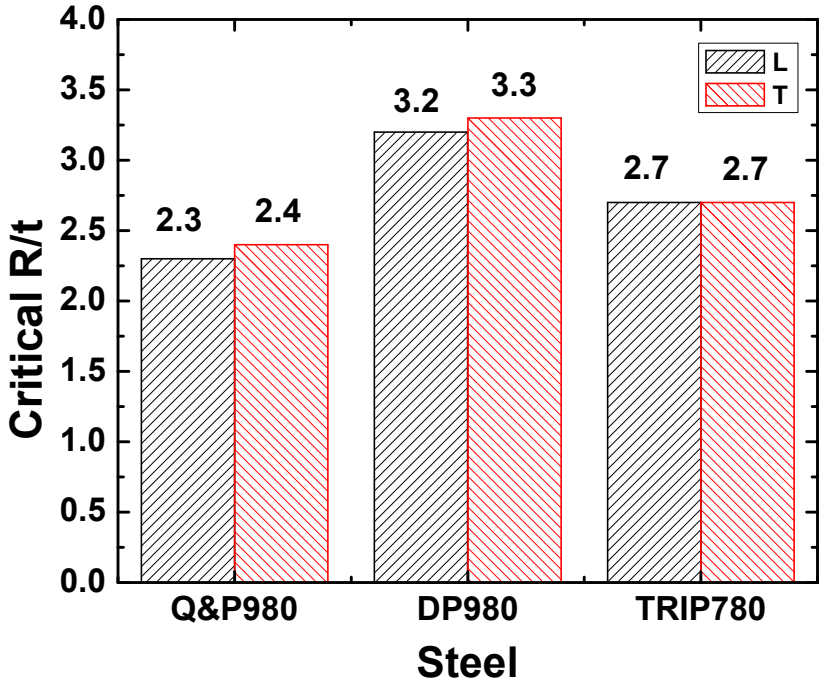




● Critical R/t


LOAD CELL
GRIP
DISPLACEMENT
BACK TENSION
HYDRAULIC CYLINDER
ROLLER
ASSEMBLY
SHEET METAL STRI
GRIP
LOAD CELL
MTS HYDRAULIC
ACTUATOR


Front Stress
Back Stress
Peak Stress (MPa)
R/t
1100
1000
900
800
700
600
500
400
300
0
2
4
6
8
10
12


Critical R/t
Steel
L
T
2.3
2.4
3.2
3.3
2.7
2.7
Q&P980
DP980
TRIP780
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0

● *Weldability*

C_{eq}=C + Mn/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15 < 0.44

Ceq= C+Mn/20+Si/30+4S+2P < 0.24

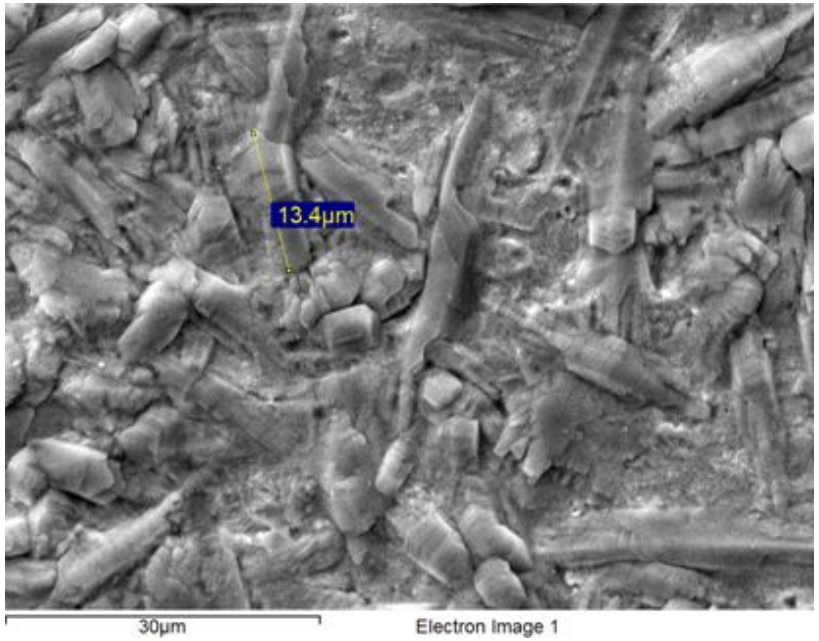
some customers： C < 0.10%

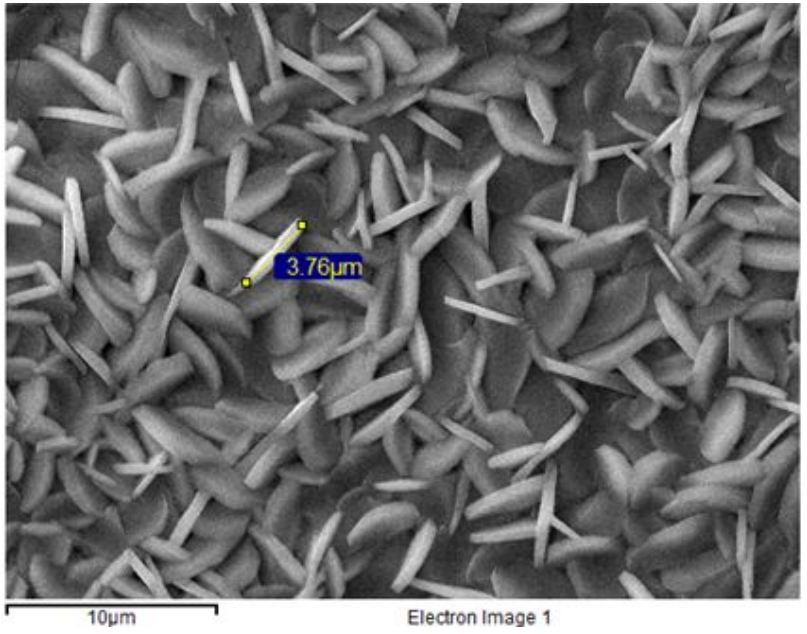
Challenge:

AHSS need C, Mn, Si, and alloying (Cr, Mo …) for strength and ductility

Tight control of P and S

Phosphability





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AHSS are the fastest growing segment of steel for automotive applications

Production and application of AHSS is a challenge for the steel and automotive industry

Dynamic research environment and "a Moving Target" is another challenge for steel development

Implications of High Mn Alloys on Recycling and ...

Activities distributed among several Partners can improve new materials from lab. to commercial(Materials research (universities) ,Vehicle design, manufacturing and performance simulation (industry),data architecture (industry))

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Thank you
for your attention !