

Alt+Ctrl+Trans

08/06/2021

Alt+Ctrl+Trans Laser Cladding



EXPERIENCE THE LASER CLADDING ADVANTAGE

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About this presentation:

Laser cladding is sometimes positioned as a replacement for hexavalent chrome.

What is the experience at Laser Cladding Venture?

Can industry transition from Cr6 to Laser cladding?

About Laser Cladding Venture

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What we offer?

**Wear protection
for critical assets**



Stellite 21 wear layer in
petrochemical compounder

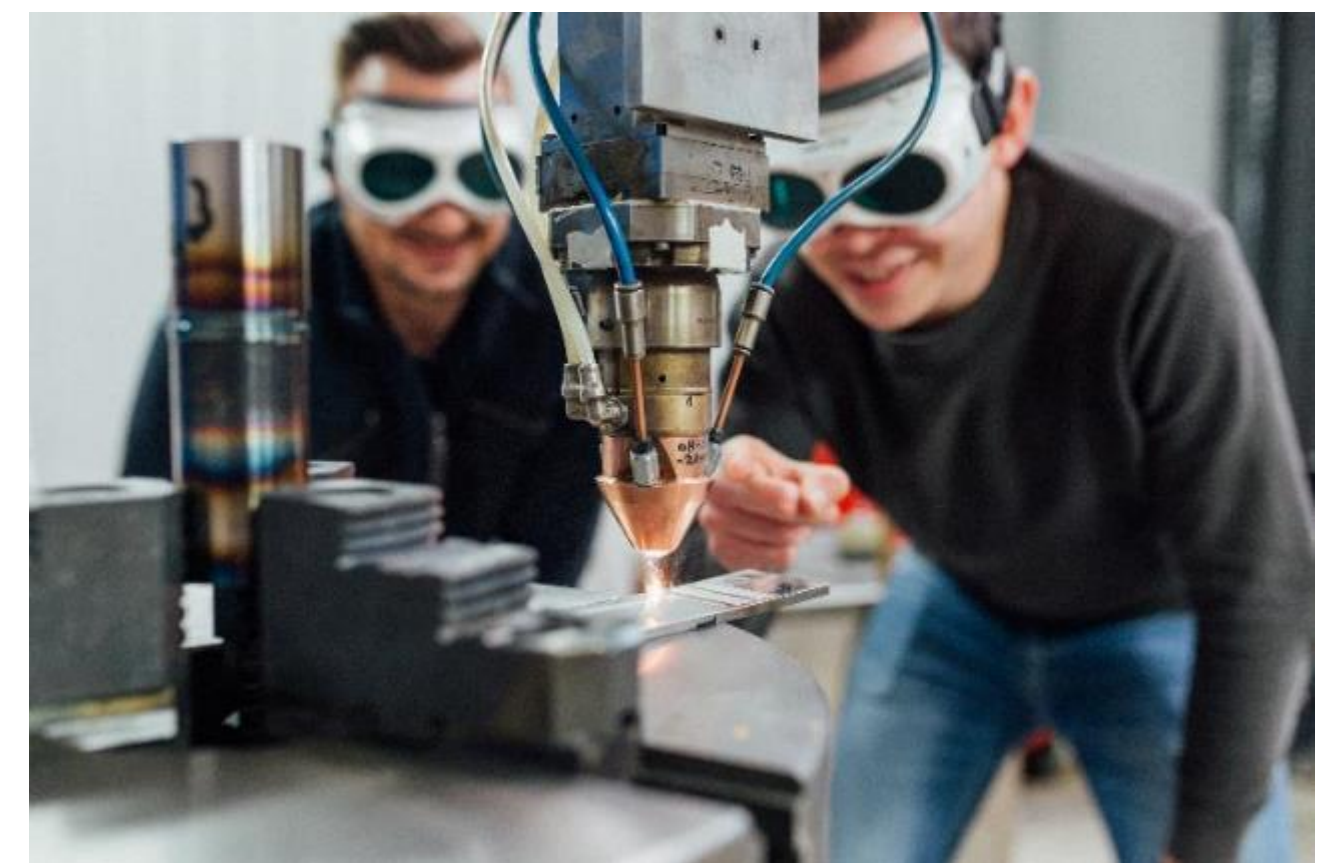
**3D printing
development**



Target application; space
propulsion in collaboration
with ESA and Ariane Group

How do we do it?

**Laser cladding with focus on
industrial manufacturing**



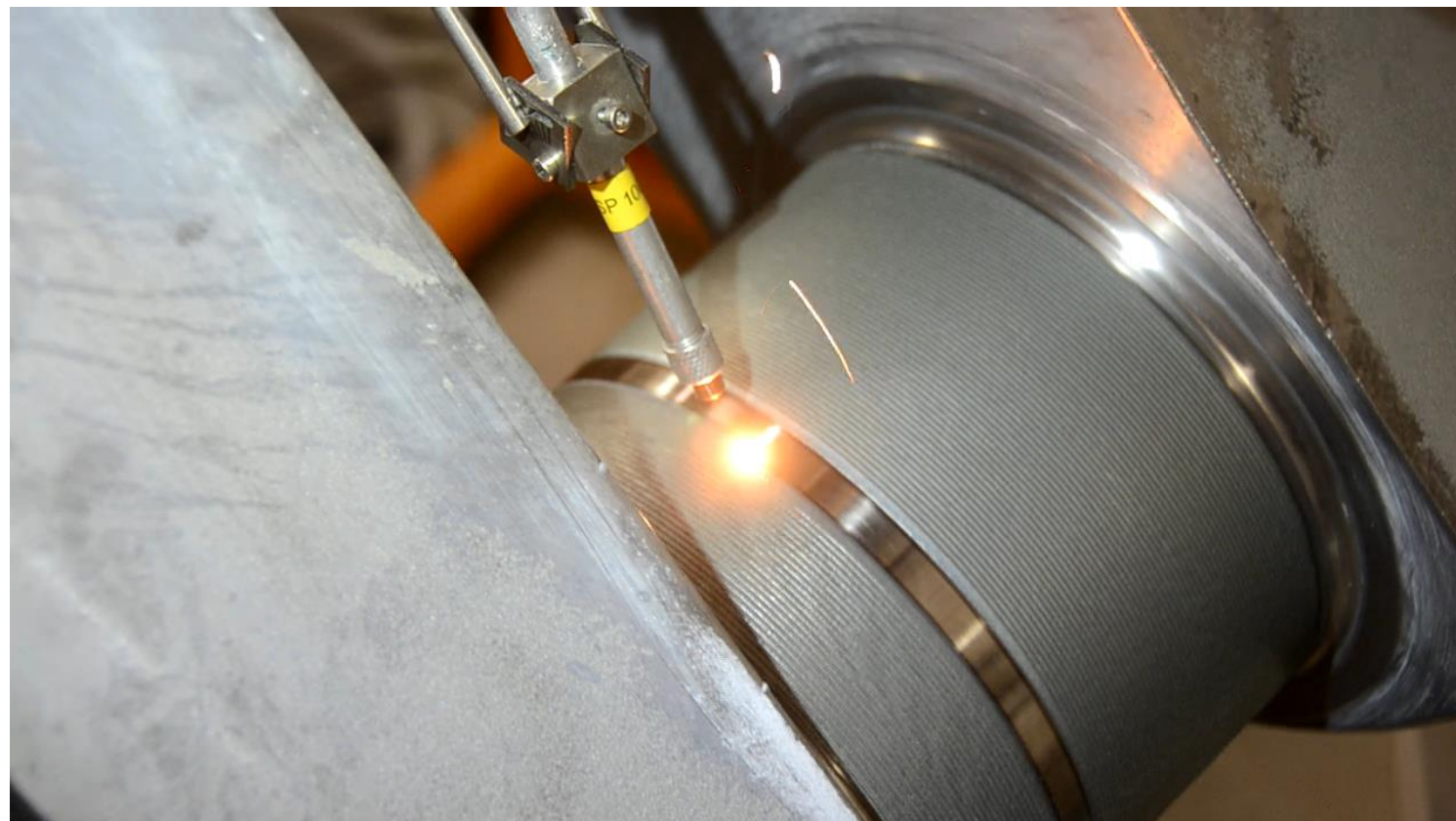
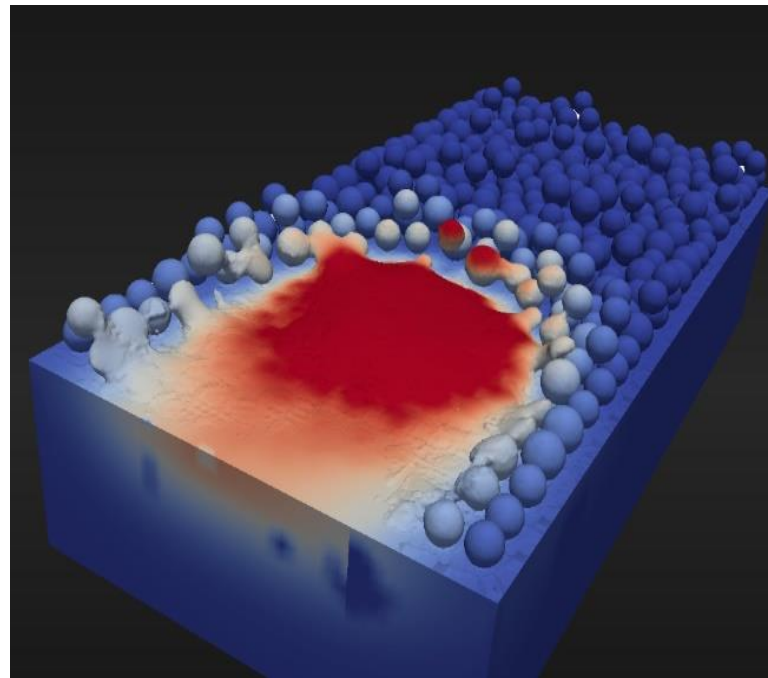
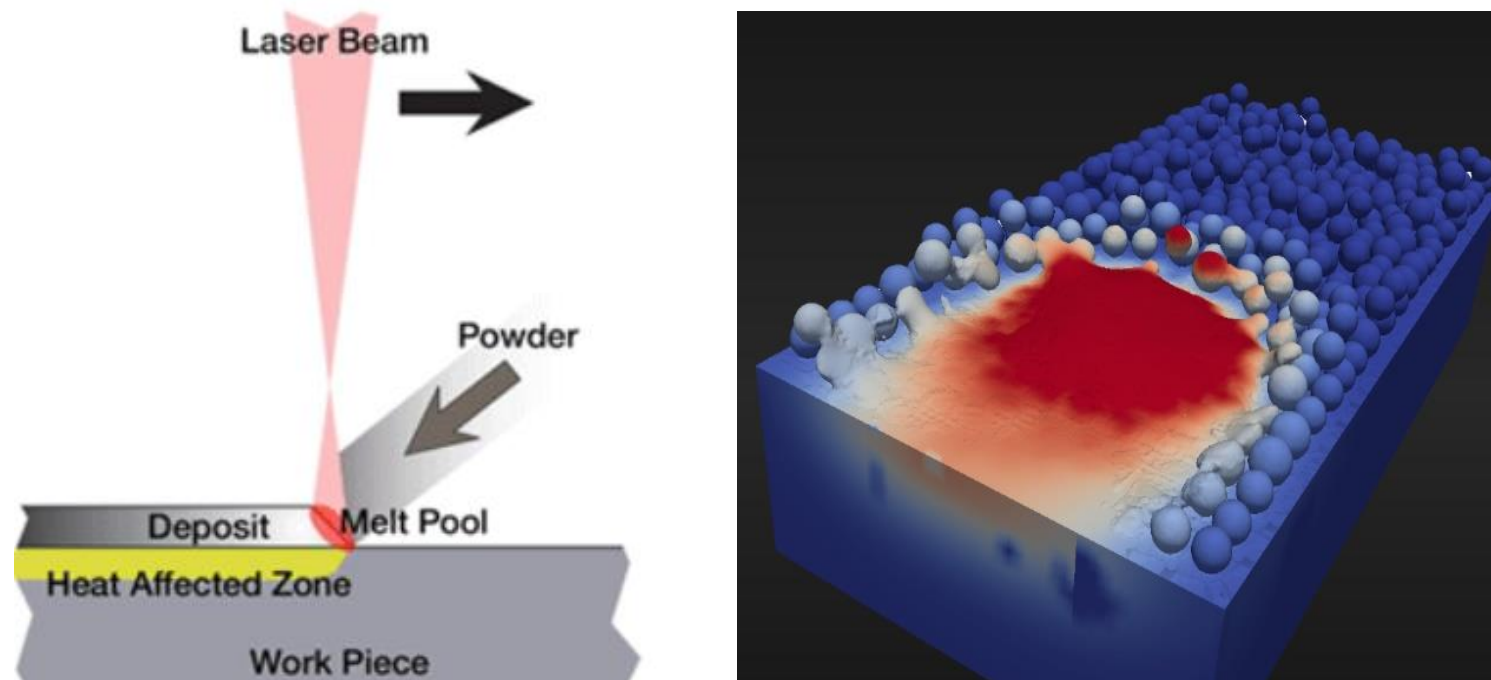
Laser cladding process
development

Laser cladding technology

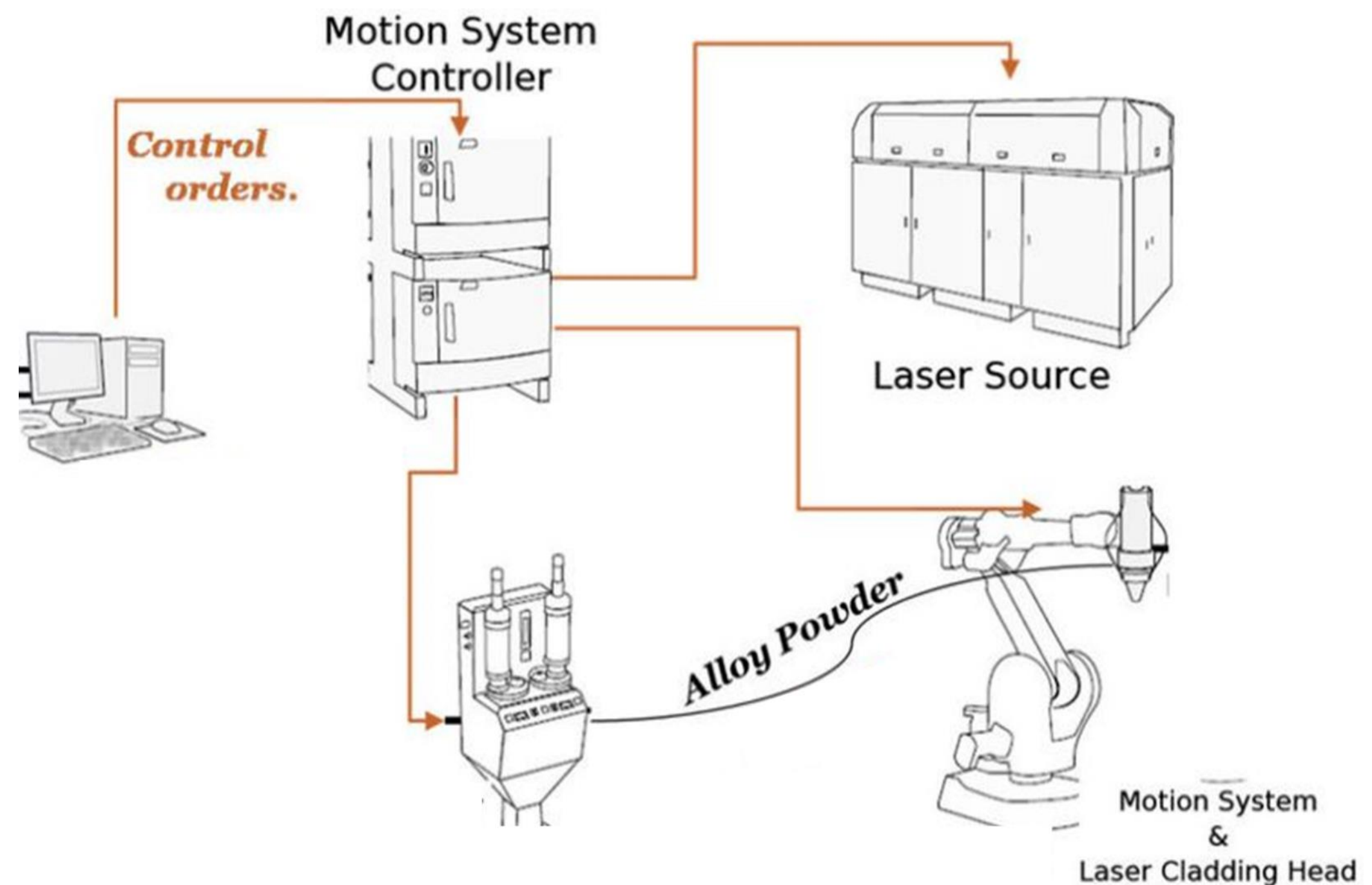
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Laser cladding or Laser Metal Deposition
i.e. powder based weld-overlay using high-power laser

Downstream: process



Upstream: hardware



Markets

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HYDRAULICS



STEEL MANUFACTURING



PETRO CHEMISTRY



GROUND ENGAGEMENT



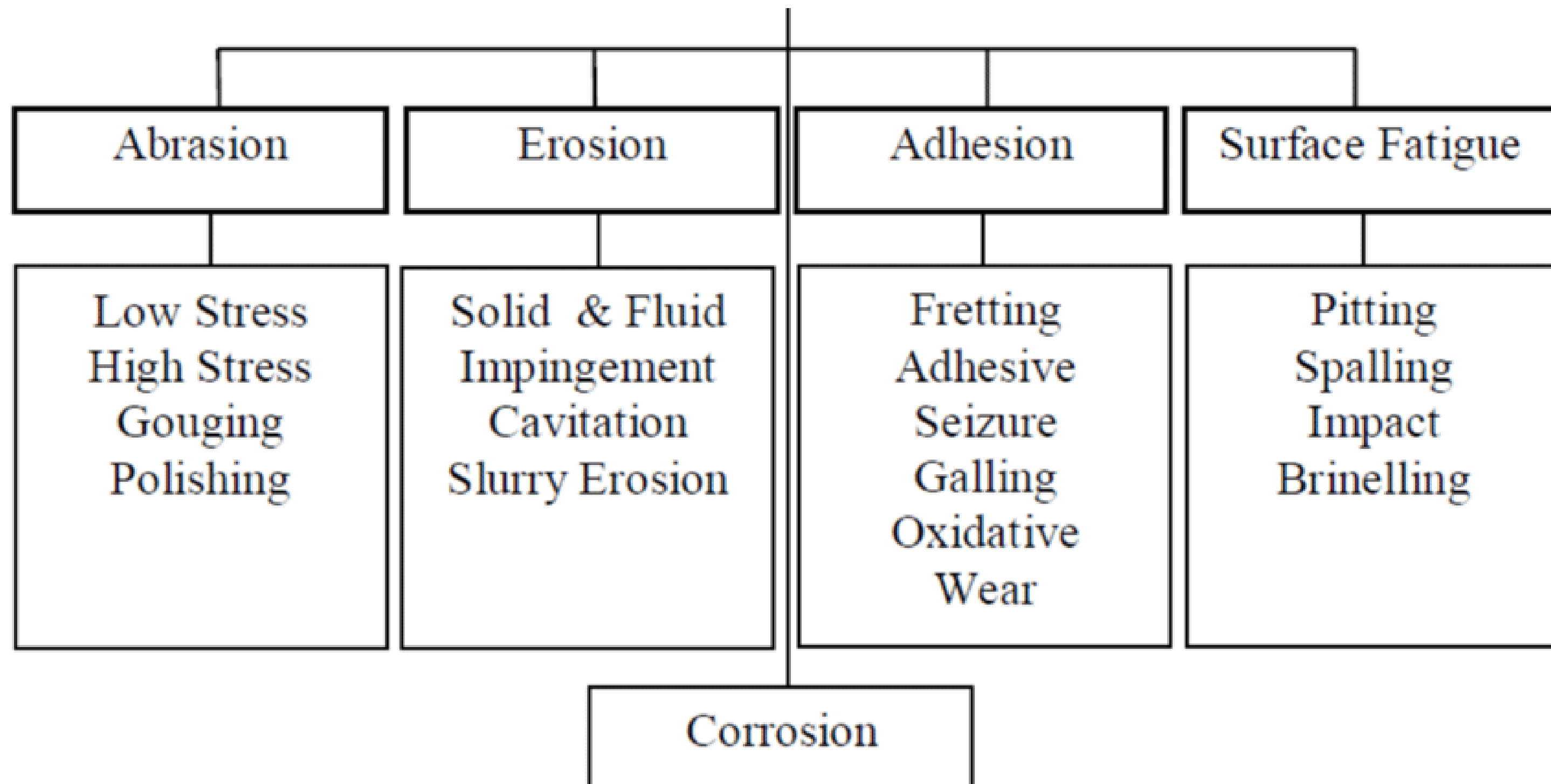
References



ArcelorMittal



Wear



Hard-facing technologies

Weld-overlay



High heat input and
high dilution

Thermal spray



High heat input and no
metallic bond

Laser cladding



Low heat input, low
dilution, metallic bond

Laser cladding benefits

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Strong USP development within the "hardfacing" niche : *Laser cladding coatings are....*

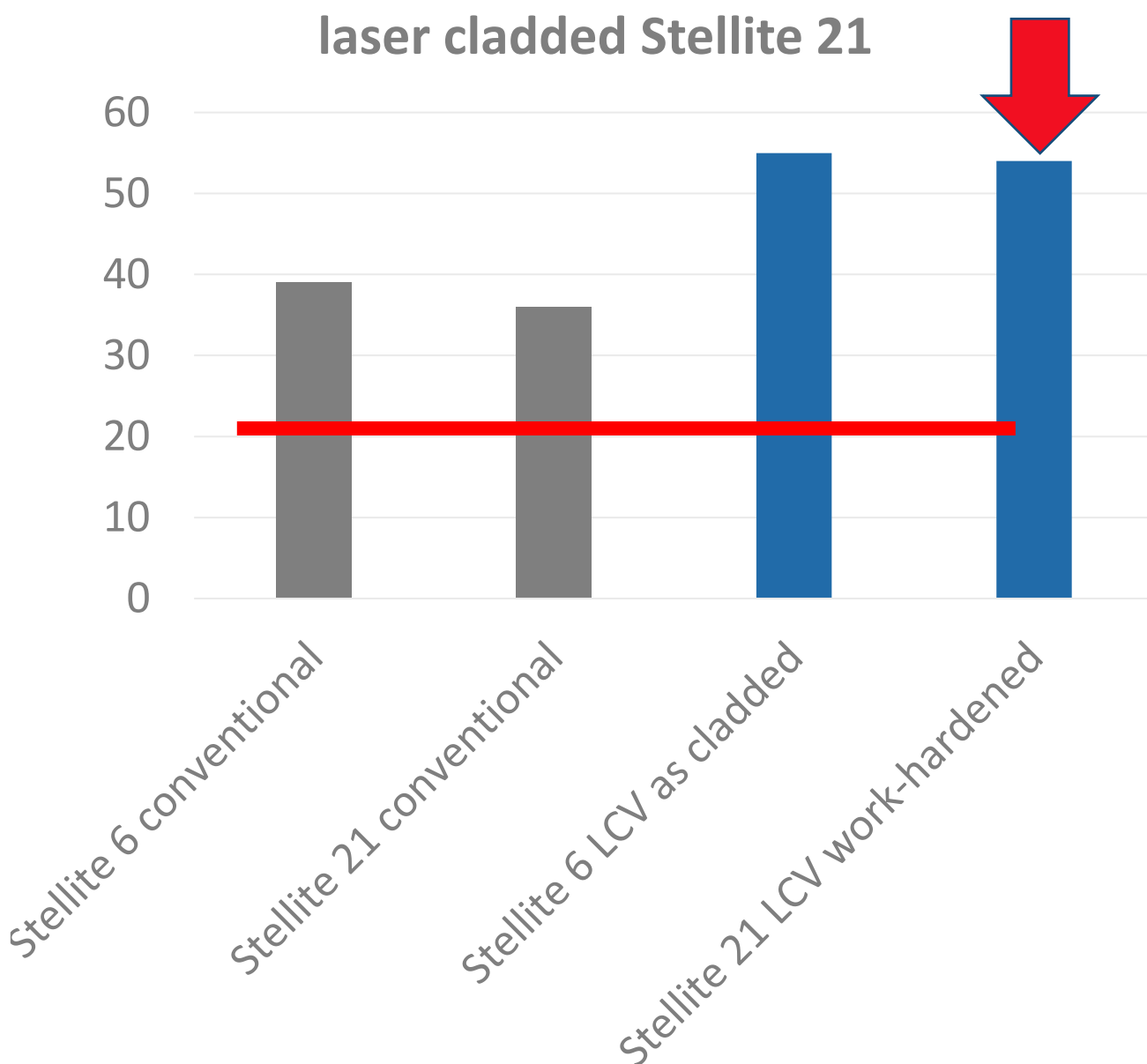
20% HARDER

than conventional welded coatings and metal spray coating

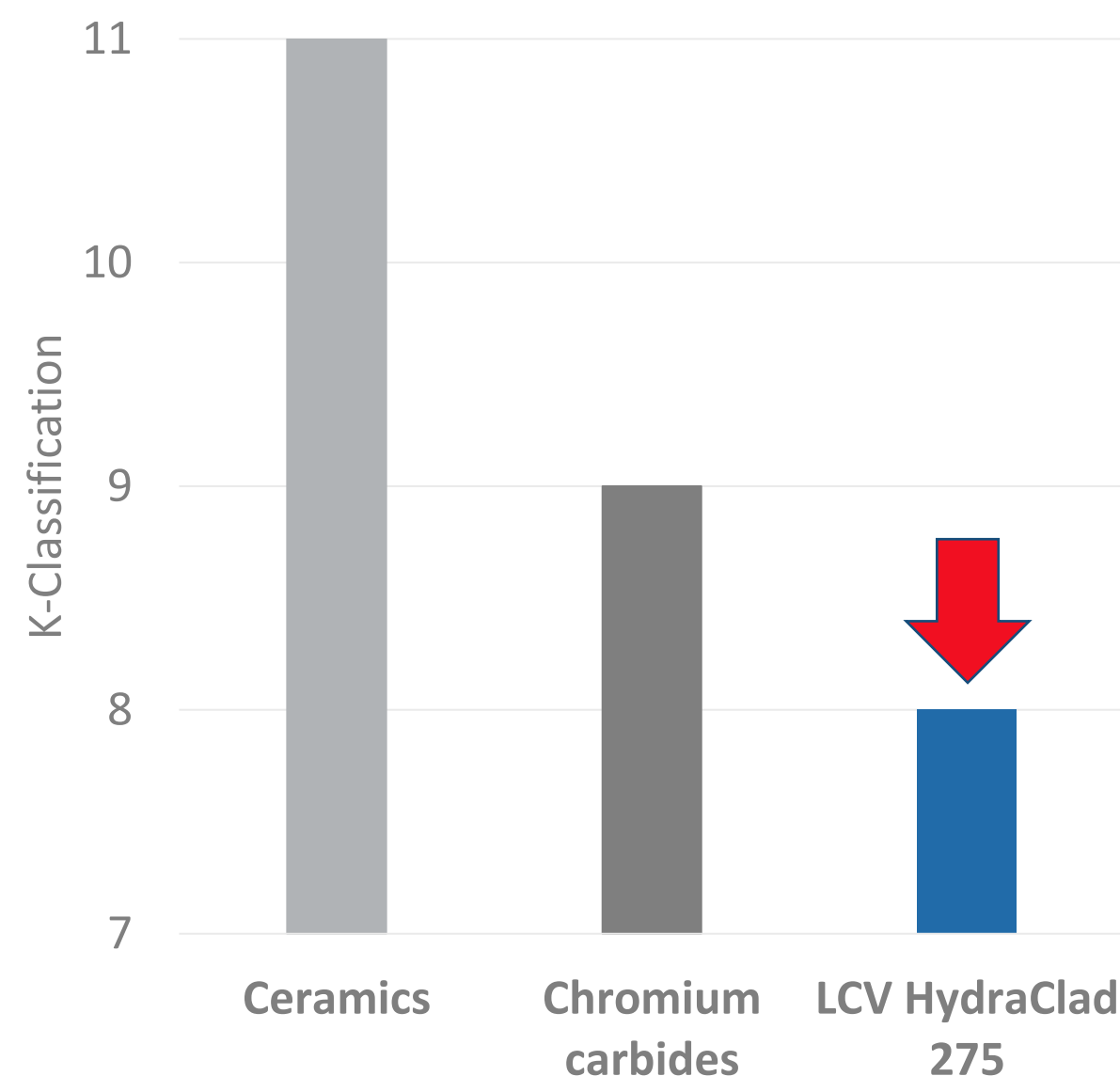
Up to 4 times more wear resistant

Up to 30% material saving

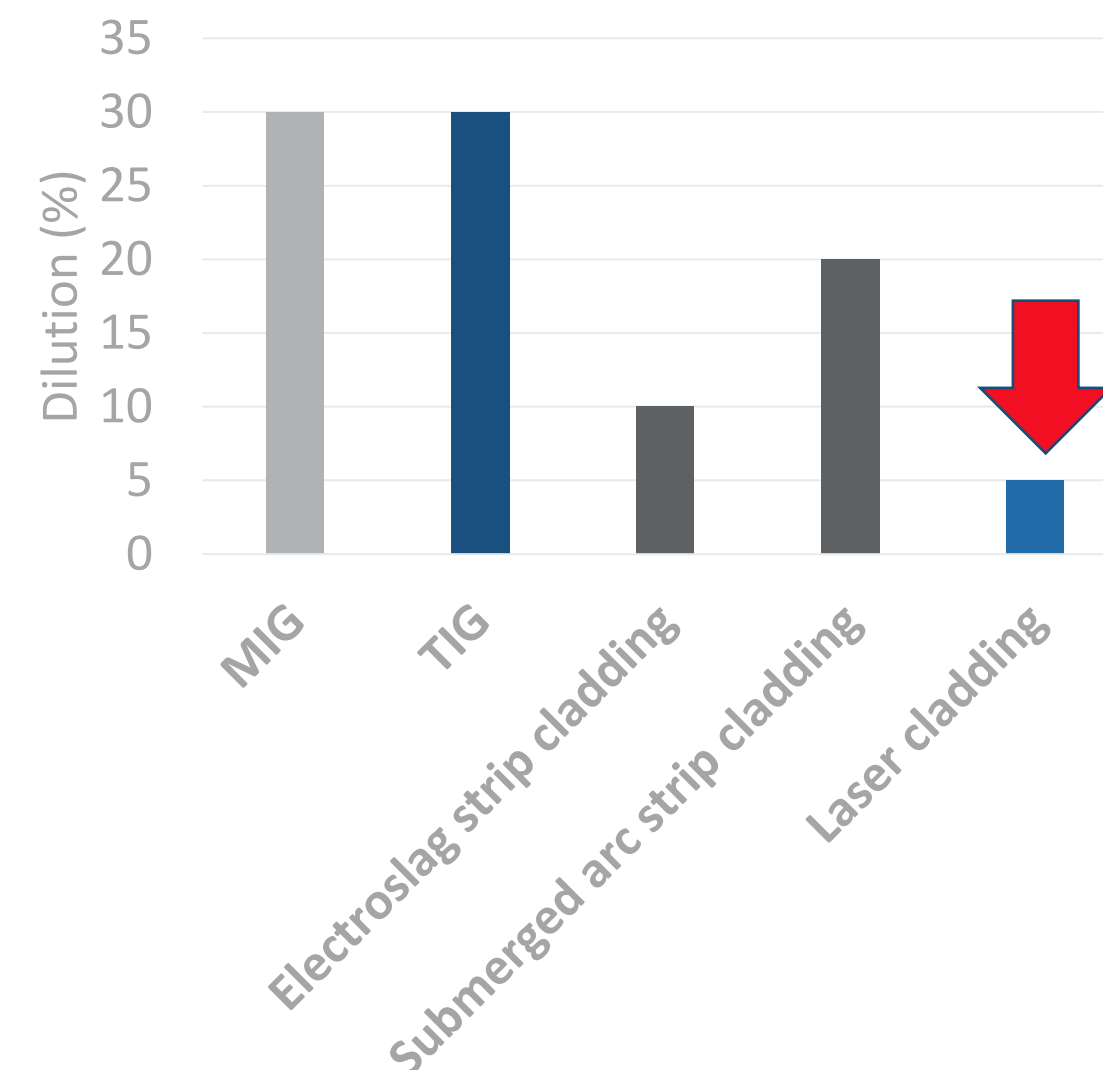
Comparison conventional Stellite with laser clad Stellite 21



Laser cladding Inconel TCC coating comparison

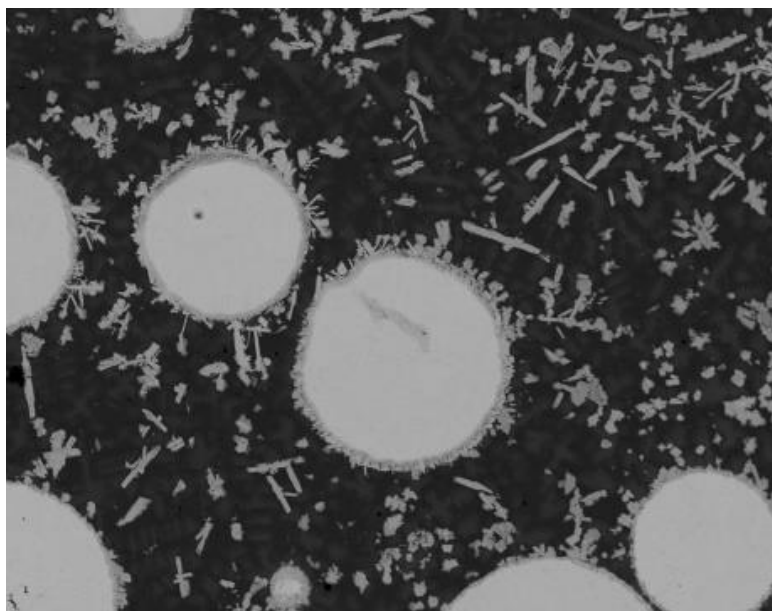
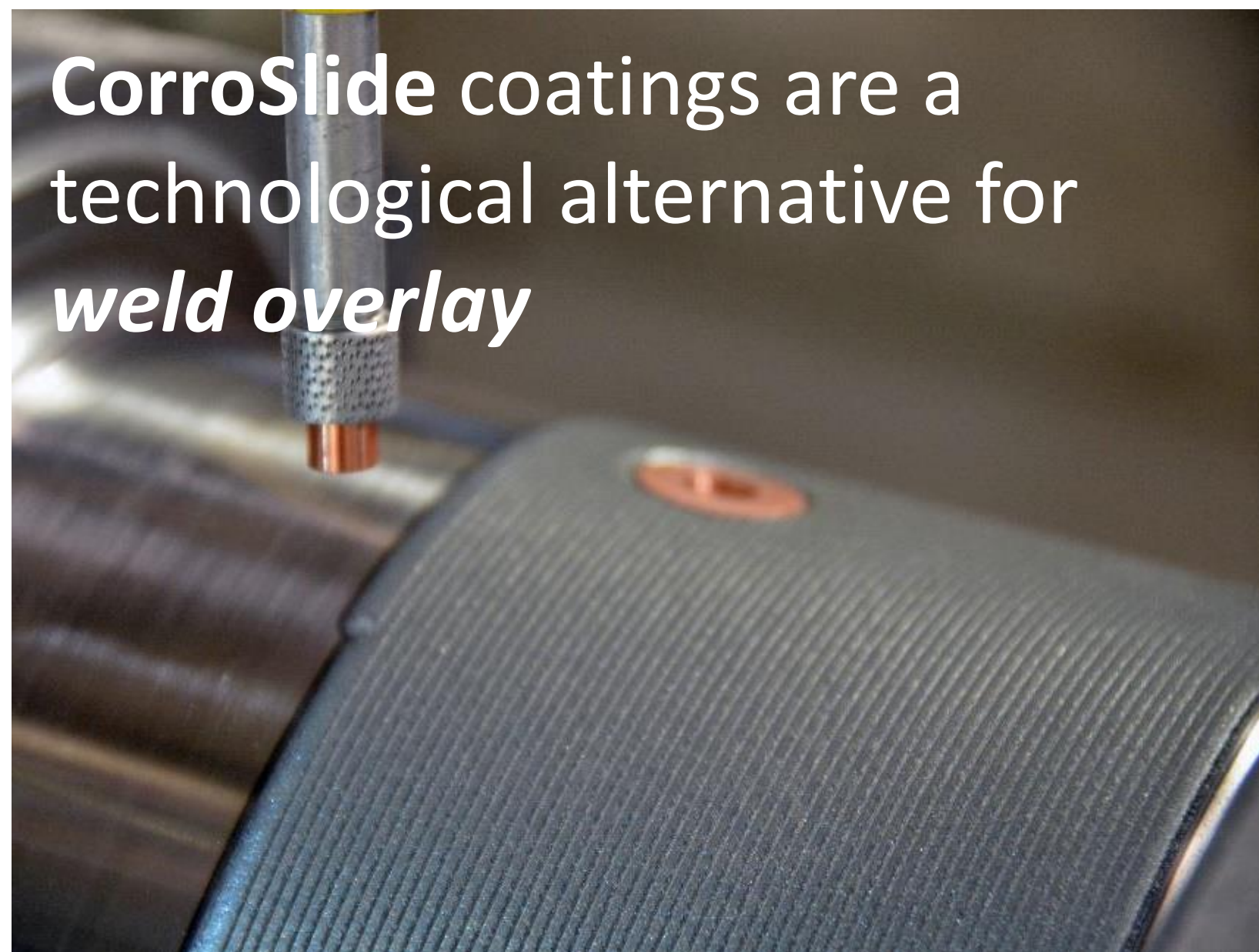


Comparison in dilution



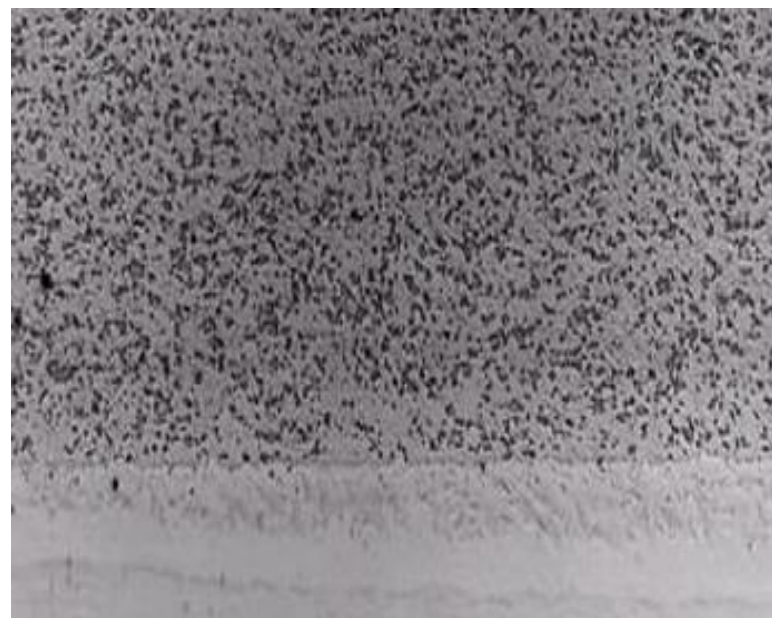
Coating Products

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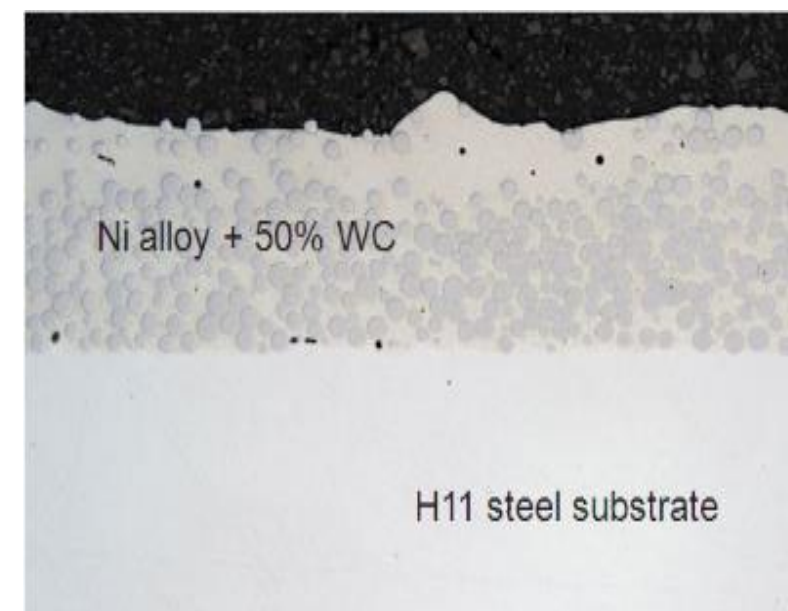
CorroSlide

Fine microstructure
Carbide integration
Low dilution



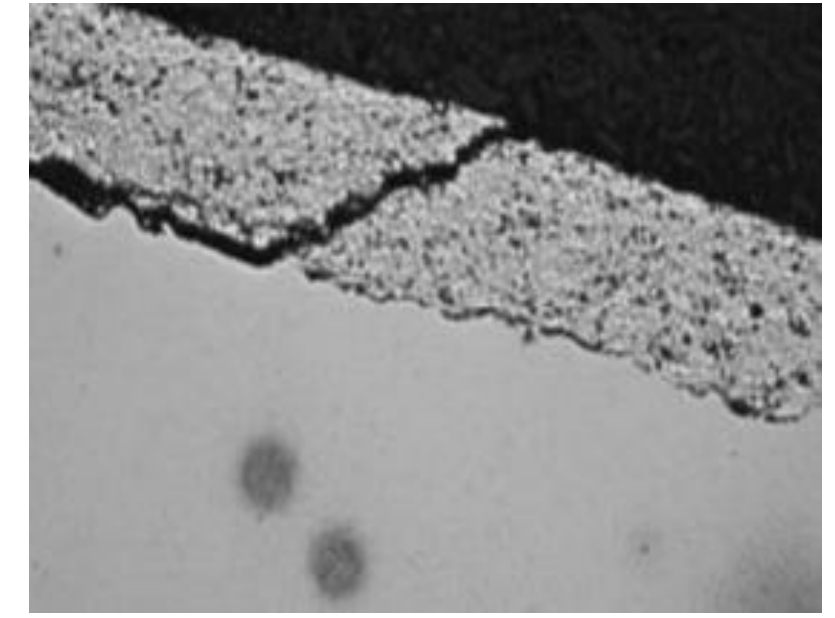
MIG/TIG/PTA...

Coarse microstructure
Dispersed carbides
High dilution



UltraClad

Full density
Metallurgical bond

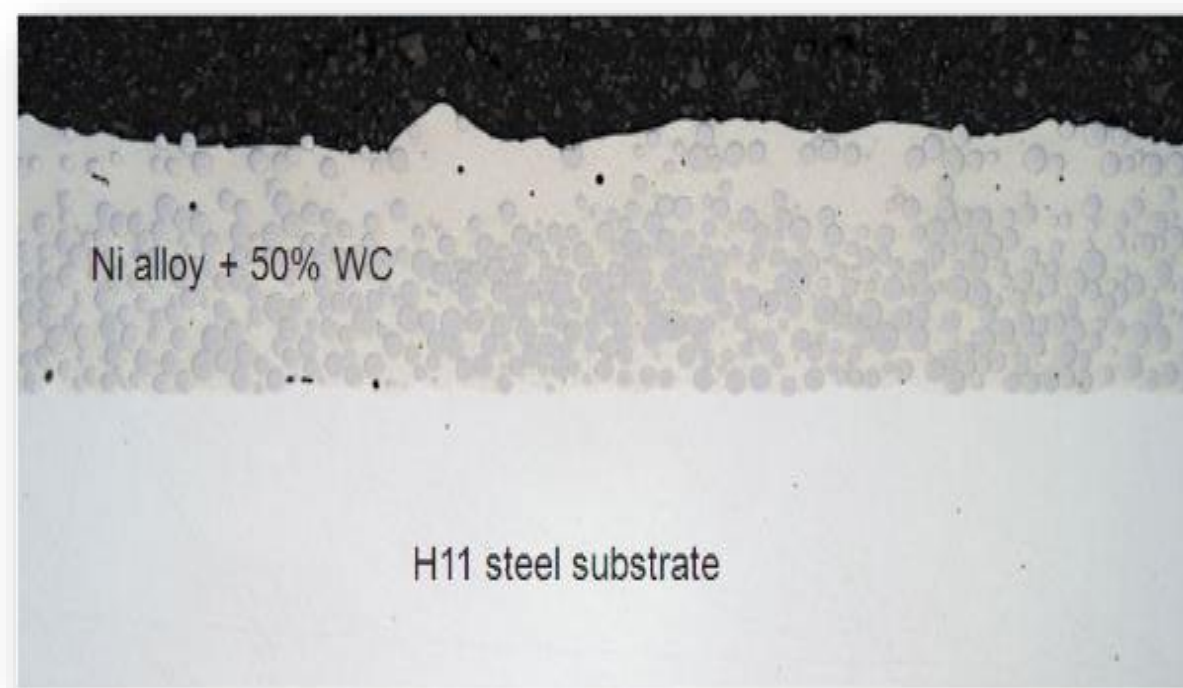


Thermal spray/HVOF...

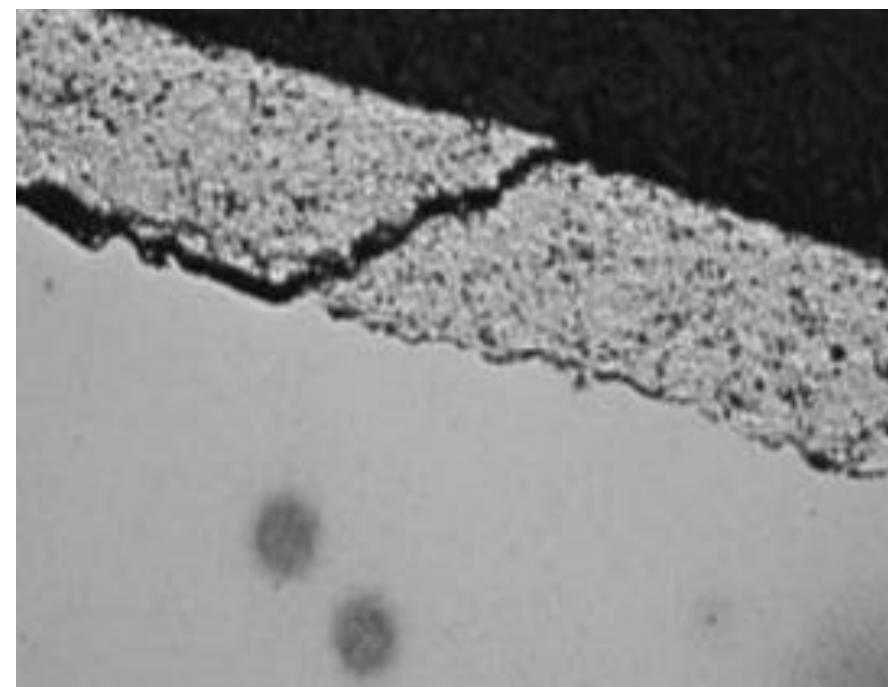
Sintered structure
Mechanical bond

UltraClad Qualitative Analysis

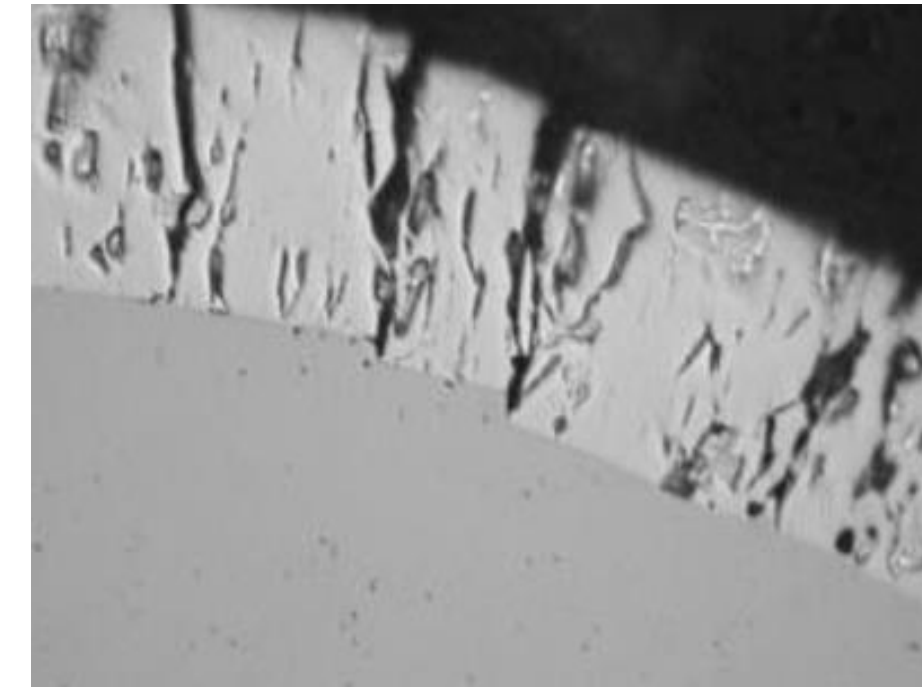
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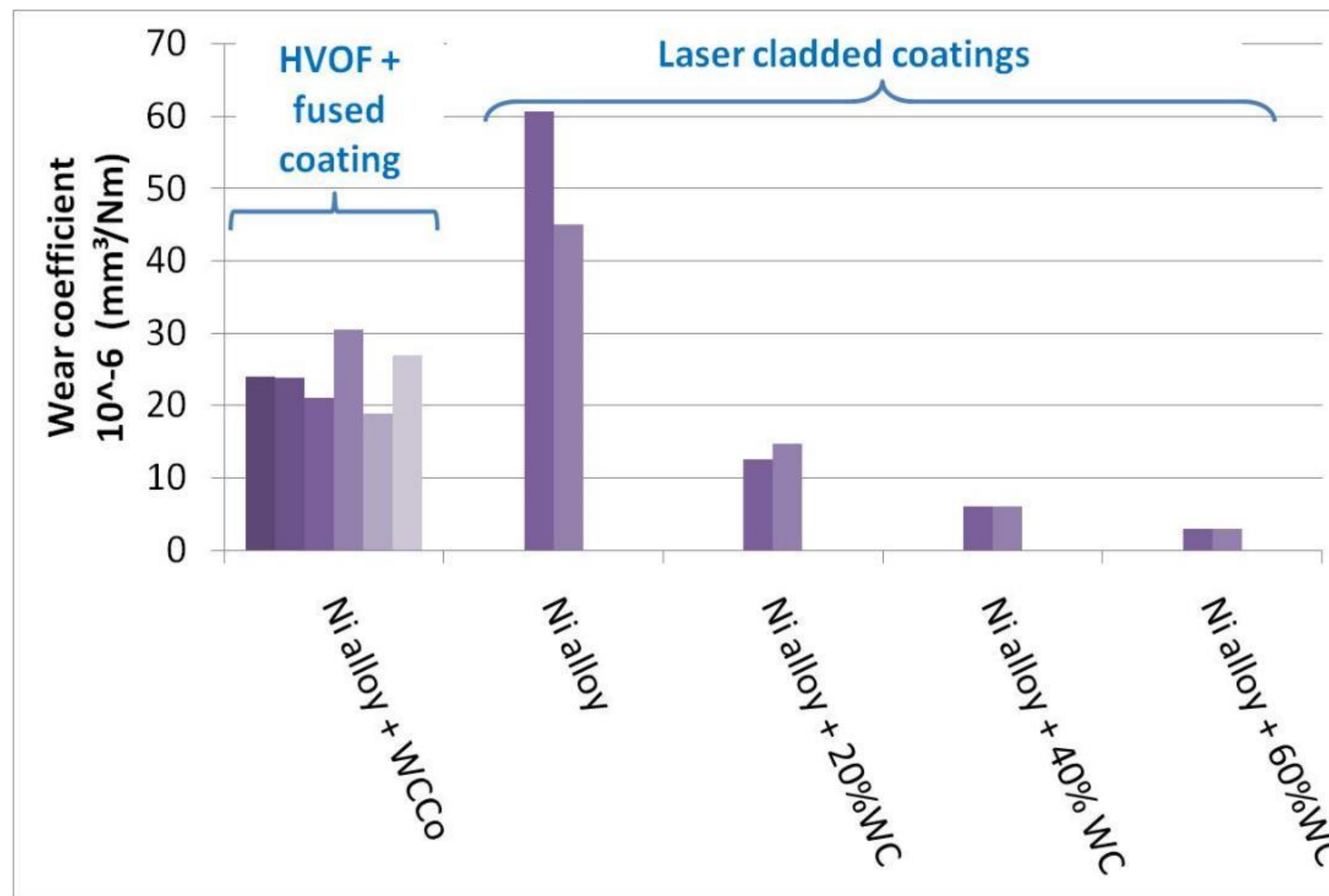
UltraClad
Full density
Metallurgical bond



Thermo-spray
Sintered structure
Mechanical bond



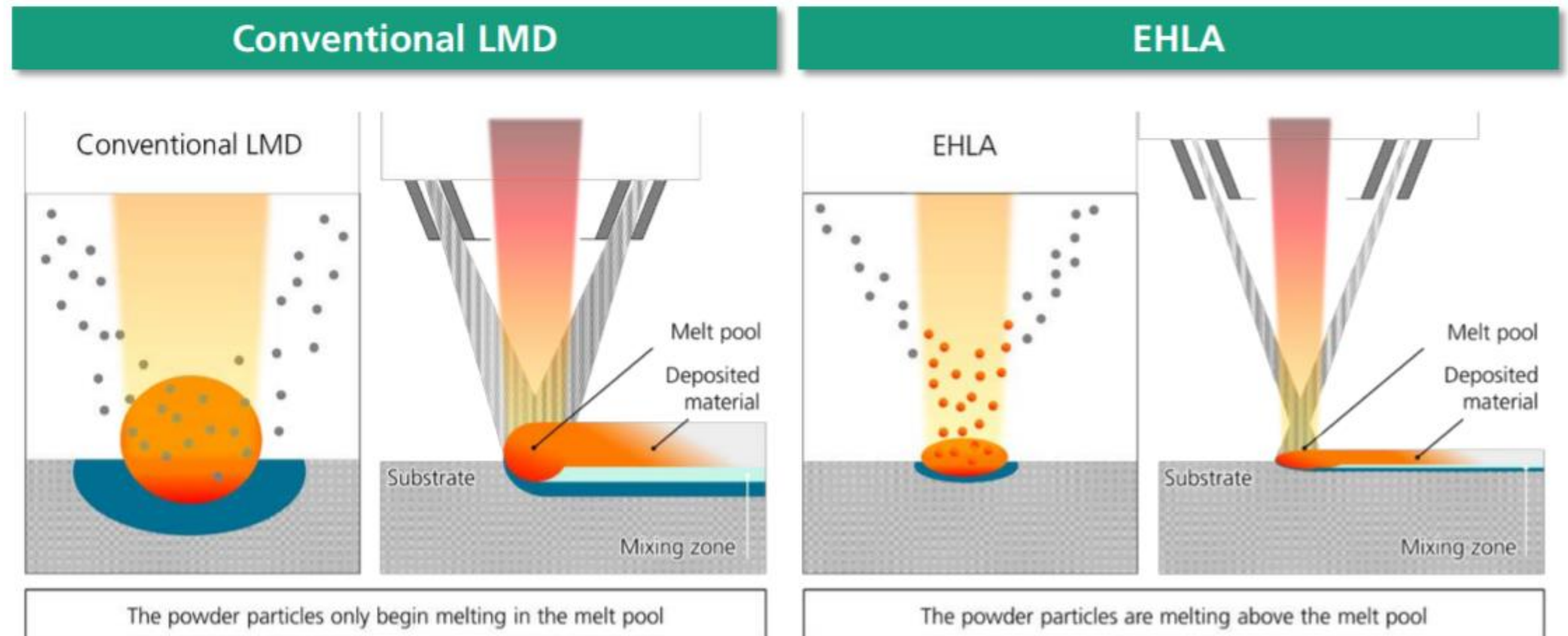
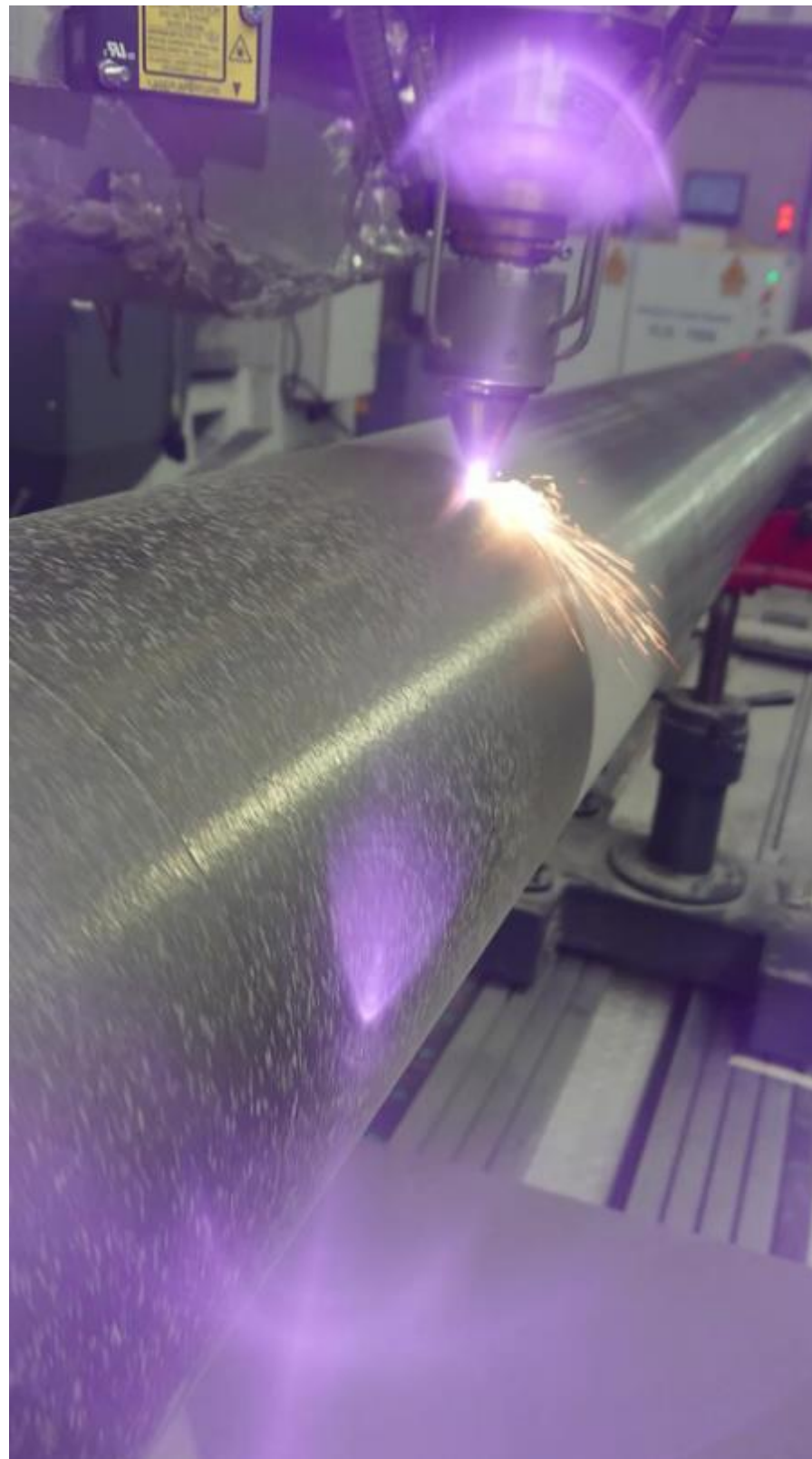
HCC
Not dense
Chemical bond



High speed cladding or EHLA

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- For rotative laser cladding of UltraClad coatings
- Up to 8 meters clad length



Energy distribution CorroSlide

SUBSTRATE – 80%

FILLER MATERIAL – 20%

Energy distribution UltraClad

SUBSTRATE – 20%

FILLER MATERIAL – 80%

Typical Materials

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Weld-overlay for corrosion protection => **USP – corrosion properties with less material**

Type	Material	Hardness HRC	Ductility	Corrosion	Process Temp (°C)
Ferro-based	304L	21	++++	++	420
Ferro-based	316L	22	++++	++	530
Ferro-based	431L	54	++	+++	530
Ferro-based	17-4 PH	35-40	+++	+++	316
Nickel-based	Inconel 625	36	++++	++++	900
Nickel-based	NiCrBSi	40	+++	+++	600
Nickel-based	Hasteloy C22	35	+	++++	550
Titanium-based	Ti 6Al4Va	36	+	++	500

Hard-facing for wear protection => **USP – improved wear resistance**

Type	Material	Hardness HRC	Ductility	Corrosion	Process Temp (°C)
Cobalt-based	Stellite 6	54-59*	++	+++	800
Cobalt-based	Stellite 21	52*	+++	+++	800
Cobalt-based	Stellite 21+TCC	60-68	-	+++	800
Nickel-based	Inconel 625 + TCC	52-62	++++	++++	900
Nickel-based	NiCrBSi	40	+++	+++	600
Nickel-based	NiCrBSi + TCC	58-68			600
Ferro-based	316L + TCC	52-60	++++	++	530
Ferro-based	SS55	55-59	+	-	400
Ferro-based	H13	50	+	-	400
Ferro-based	M2	60	-	-	400

Is Laser Cladding Expensive?

→ “EHLA” HydraClad based productivity

2015 – 70 EUR/DM²

Now – 12 EUR/DM² grinded at 0,2Ra



HydraClad
50

50µm

Chrome
alternative

HydraClad
100

100µm

NiCr
alternative

HydraClad
275

275µm

LC &
Ceramic
alternative

HydraClad
900

900µm

Weld
overlay
alternative

In-house LMD-AUTO technology

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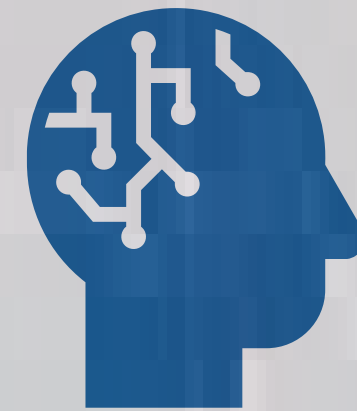
- Promote yield and uptime
- Enable turn-key operation
- Based on Industry 4.0 technology
- CRUX: process expertise as part of machine control



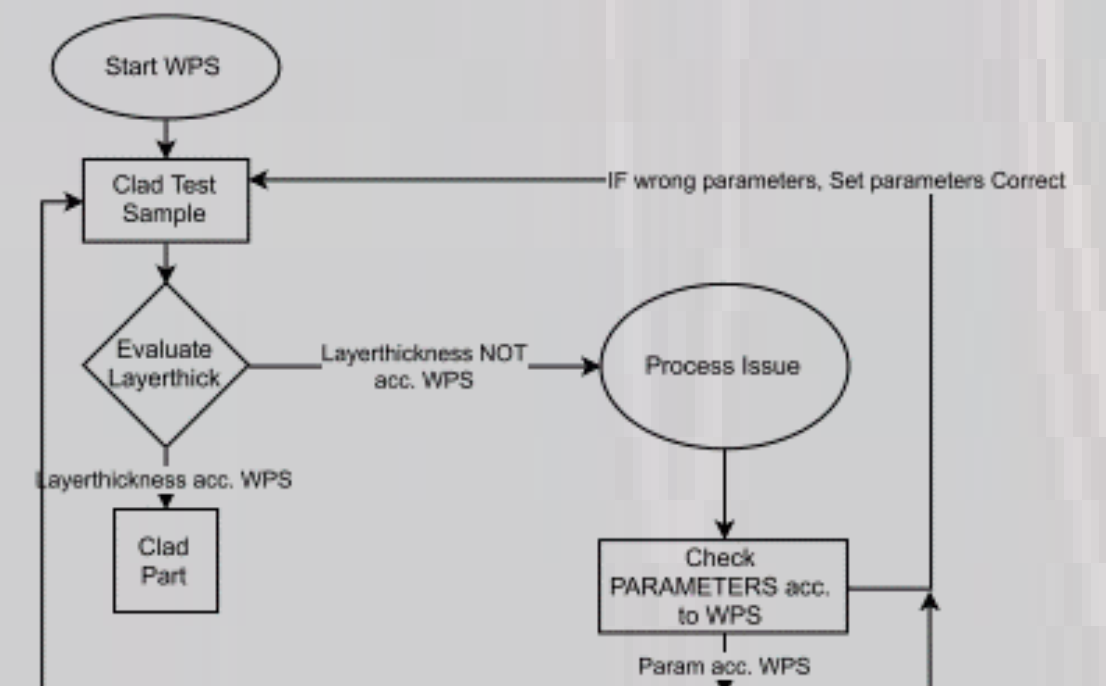
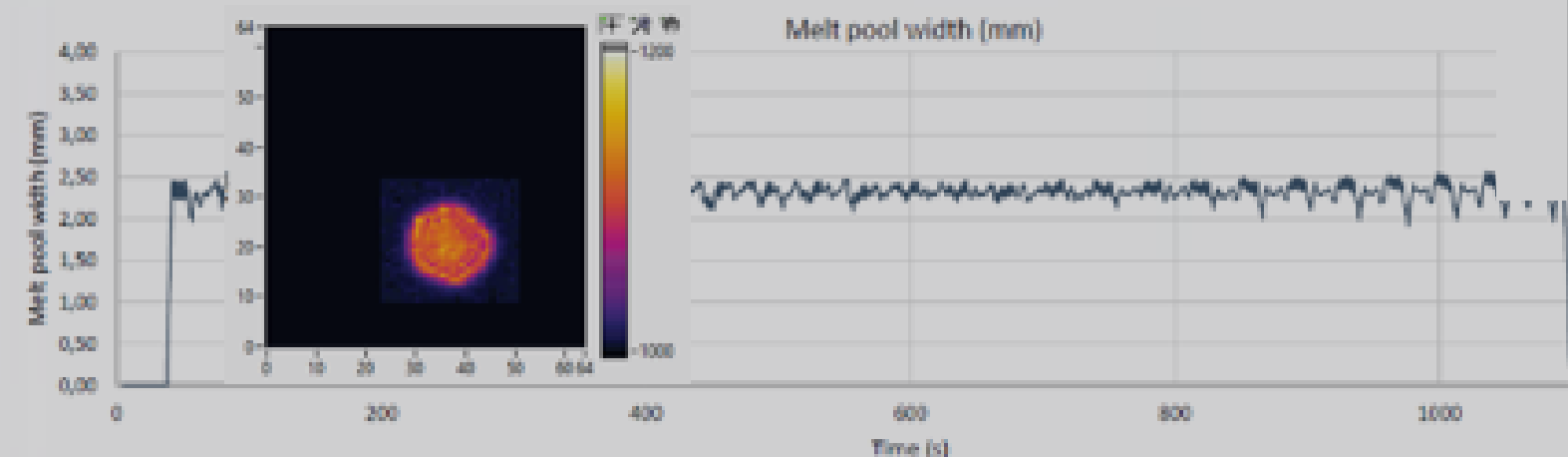
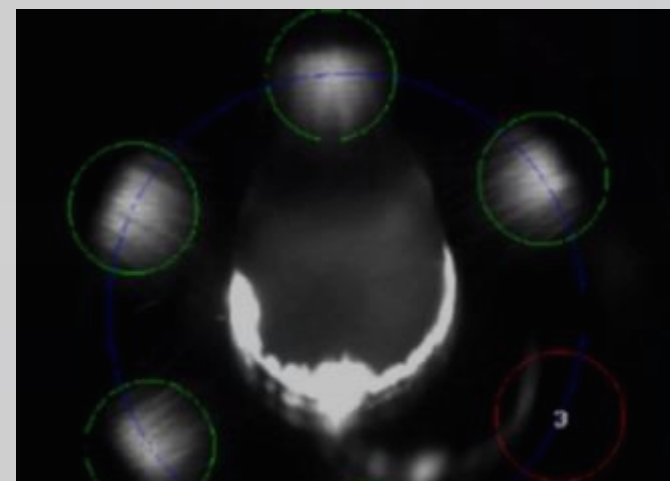
Up & downstream
vision & sensing



Active hardware
and quality control



Turn-key process
automation



Solutions for hydraulics

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Endurance-tested, application specific materials for hydraulic coatings

HydraClad Inconel 625 TCC

Test	International standard	Minimum requirements	LCV standard
Hardness	Vickers test EN ISO 6507	300HV min, HAZ 350HV max	668 HV
Bend Test	ASTM B571-97, ISO 5173 or similar mandril test	90° without cracking or peeling, no cracks at 4x magnification (edge effects must be considered)	No cracking or peeling
Tensile Adhesive Strength	EN 582 or ISO 41916	≥ 35 N/mm ²	≥ 35 N/mm ²
Corrosion Testing	ASTM G61, NBD10300	No corrosion	No corrosion
	Endurance test NBD10300	Electrochemical Permeability $> -0,35$ V No visual corrosion or local discolorations	Electrochemical Permeability $> 0,03$ V No visual corrosion or local discolorations
	DNV-C1 Salt Fog ISO9227	No corrosion, discolorisation during the test	No corrosion or discolorisation after 4200h
	DNV-C2 Destructive porosity test	No corrosion visible after 500h	>1000 h
System Wear Test	Seal-Coating interaction, friction coeff., k-factor	No leakage after minimum 1000 cycles	No leakage Wear factor $8,7 \times 10^{-12}$ K-classification 7
Impact Test	DNV-M1 Critical Impact Energy	15J minimum energy	No cracking (min. 30J)
Rockwell Indentation Test	DNV-M2 Indentation behaviour	No or neglectable brake-out or cracking around the indentation	No brake-out or cracking around the indentation
Dynamic Bending Test	DNV-M3 (4-point bending @ 0.92Rp)	No cracks after bending of minimum 500 cycles	No cracking after min. 1000 cycles
Wear Testing (Worst Case)	ASTM G105, friction coeff., k-factor	No chipping, spalling or cracking at magnification 20x	No chipping, spalling or cracking Wear factor $5,2 \times 10^{-11}$ K-classification 8
Roughness	ISO 4287-99	TBA in consideration of seal materials and operating fluid	$<Ra0,3$



Solutions for steel manufacturing

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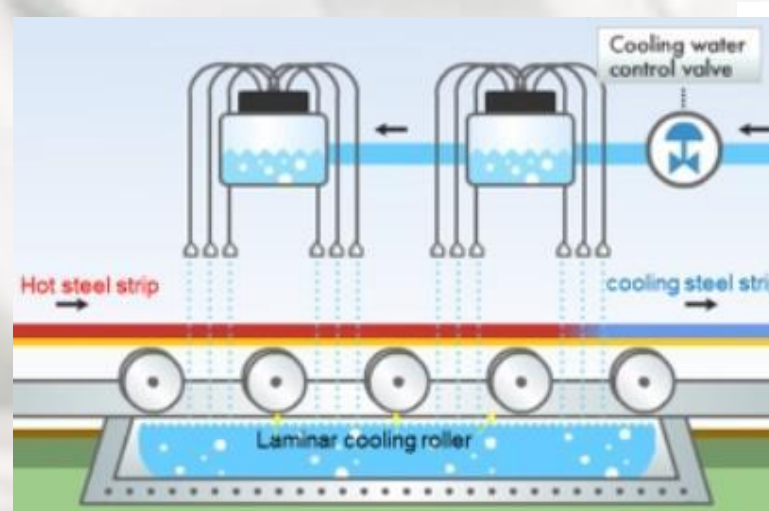
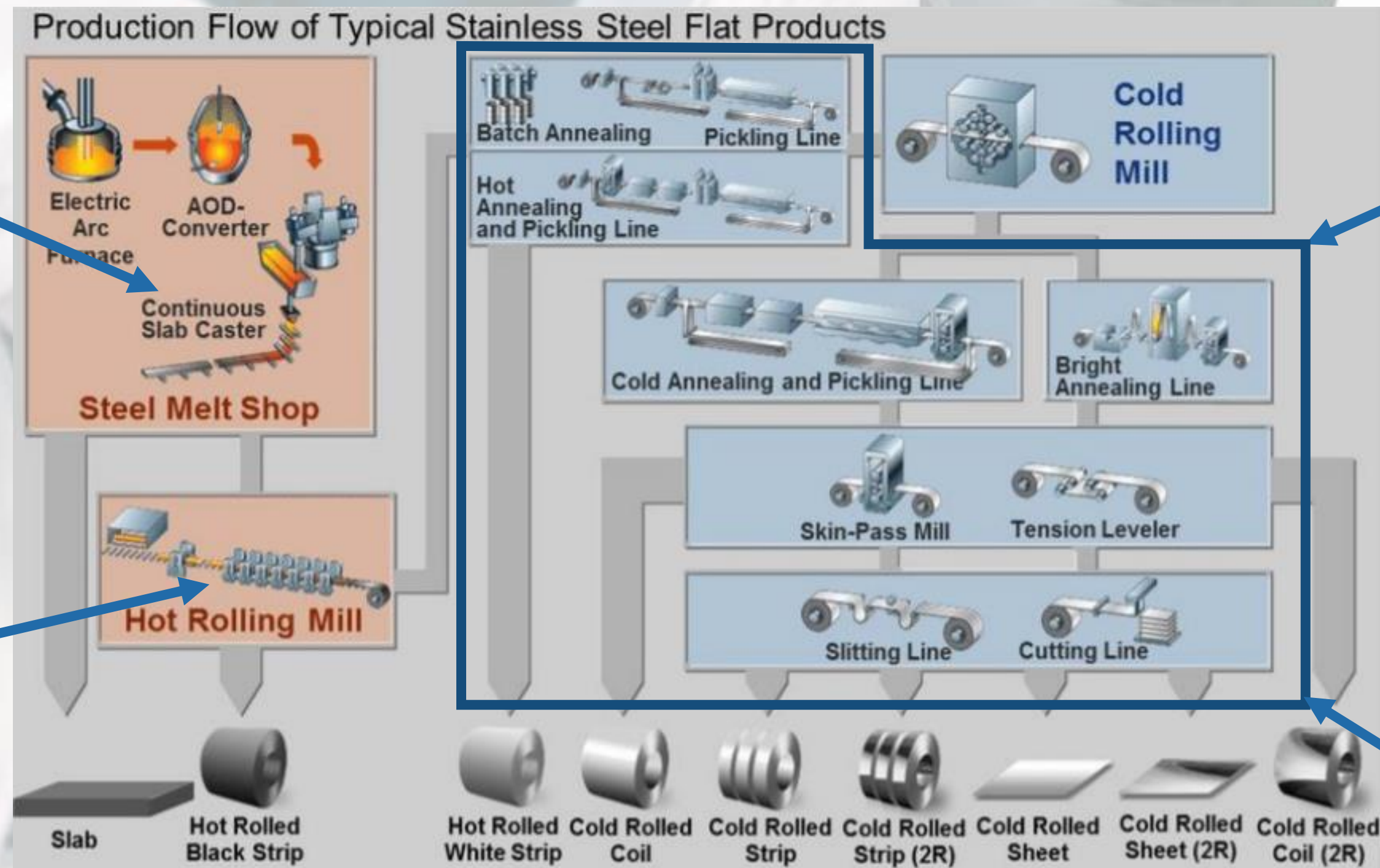
Endurance-tested, application specific materials for caster, transport, bending & levelling rolls

CorroSlide
X-402
SS55
SteelClad

CorroSlide
LCV SR -31R
SS55
SteelClad

UltraClad
Inc 625 TCC
Ni1540 TCC
Ni1620 TCC
SR-31R -UC

CorroSlide
SS55
SR -31R
Stellite 21
SteelClad



LC-SR-31 Coating

Ni60 Flame spray



- Laser cladding coating
- Hardness $\geq 55\text{HRC}$
- Metallurgy bonding
- Replace Ni60 flame spray
- Service > 2 year, passed >8000k ton of steel



CASE - HS Cladding Roofing Roll Inc 625 TCC



Conclusion

Proven technology

Excellent wear and corrosion properties, good adhesion, bending- and impact resistance

Field of use

Mainly axi-rotative parts (EHLA)

Business case

Comparable with NiCr, thicker coating >80µm

Not competitive to generic Cr6 for volume production

Available today

Contact us and our team will be at your service



Thank You

EXPERIENCE THE LASER CLADDING ADVANTAGE

Our Mission: Enable our customers to improve products & production with LMD manufacturing

How we work: Practice excellence in Laser Cladding
With a focus on QUALITY and PRODUCTIVITY

INTEGRITY, TEAMWORK, ENGAGEMENT, EXCELLENCE



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