Gussteil-instandsetzung durch Cold Spray Anlagen

KNOWHOW WILHELMS GmbH

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Qualitätsmanagement und Gießereiberatung / Audits

Gussteilinstandsetzung durch Laserschweißen

3D Metalldruck

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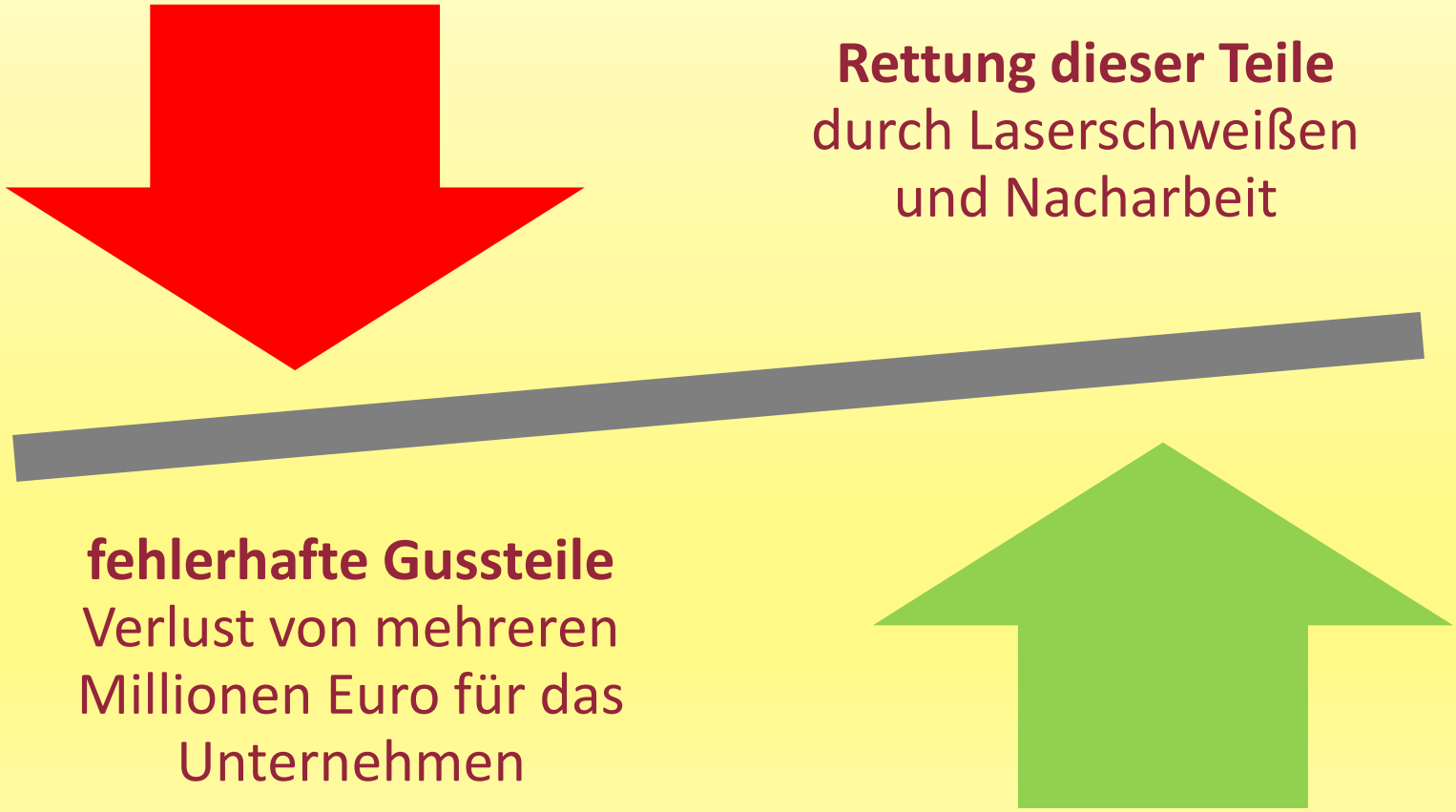
BISHER ERREICHT mit Laserschweißen

gerettete Teile seit 2014: ca. **500.000** hochwertige Teile - ca. **15 Mio. € Verlust** erspart



Rettung dieser Teile
durch Laserschweißen
und Nacharbeit

fehlerhafte Gussteile
Verlust von mehreren
Millionen Euro für das
Unternehmen

VORTEILE DES COLD SPRAY

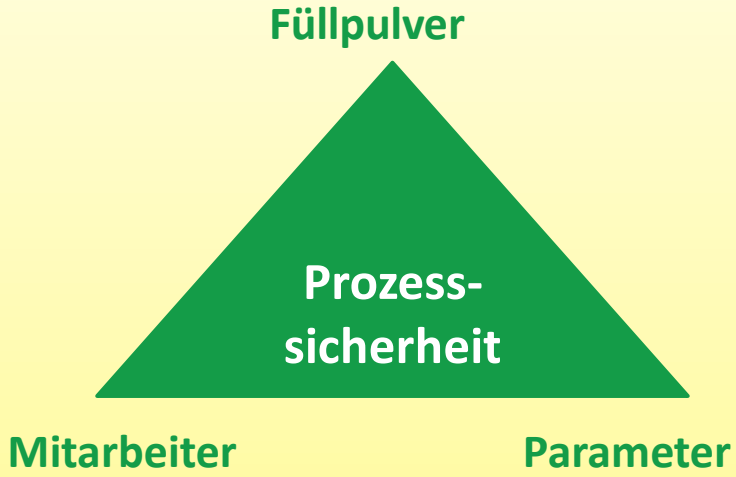
- Verschweißen von unterschiedlichen Materialien
- präziser und punktgenauer Energieeintrag
- minimale thermische Werkstoffbeeinflussung – **kein Verzug**
- keine Wärme - Einfluss - Zone
- kraftfreie Bearbeitung
- gute Prozesssicherheit und Dichtigkeit der Schweißung
- Sehr schnelle Auftragsrate von >0,5 kg /Stunde

SCHWEIßBARE LEGIERUNGEN:

- hochlegierte Kalt- und Warmarbeitsstähle
- niedriglegierte Stähle
- vergütete Feinkornstähle
- Edelstahl
- Aluminium
- Nickel
- Gusseisen
- Bronze, Kupfer
- Titan, Edelmetalle

Für alle Verfahren wie Druckguss, Kokillenguss, Sandguss, Feinguss und Materialien wie Aluminium, Magnesium, Eisenguss, Stahlguss usw. geeignet.

QUALITÄT BEIM COLD SPRAY



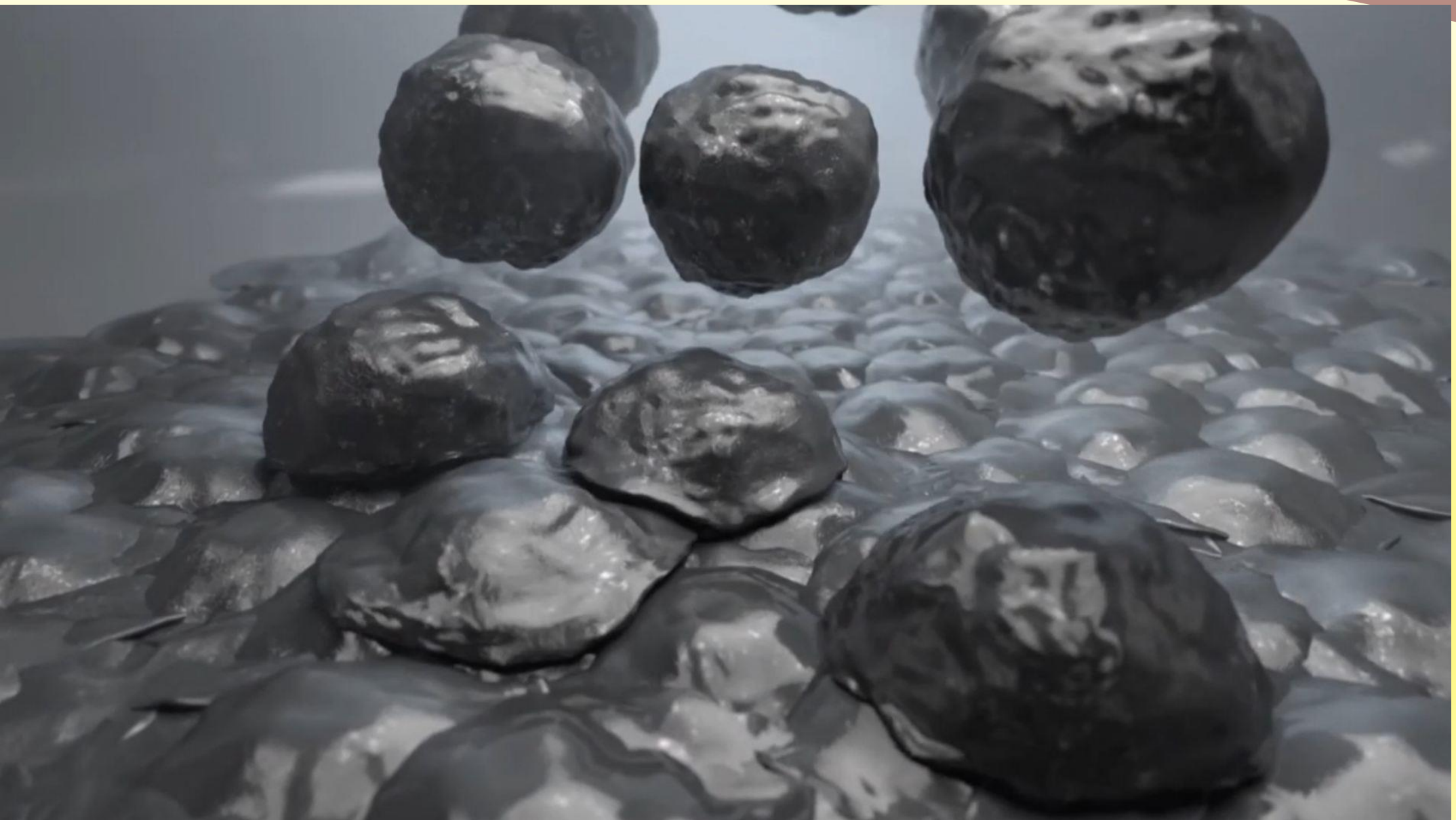
Was ist beim Cold Spray wichtig?

- manueller, handgesteuerter Prozess
- Richtiges Pulver
- Richtiger Auftreffwinkel ca. 90° Abweichung 10°
- Material punktgenau aufgebracht
  (Position / Menge)
- Keine dynamische Zugbelastung der Naht.

Vermeiden von:

Poren , erneuten Rissen , Bindefehlern

COLD SPRAY



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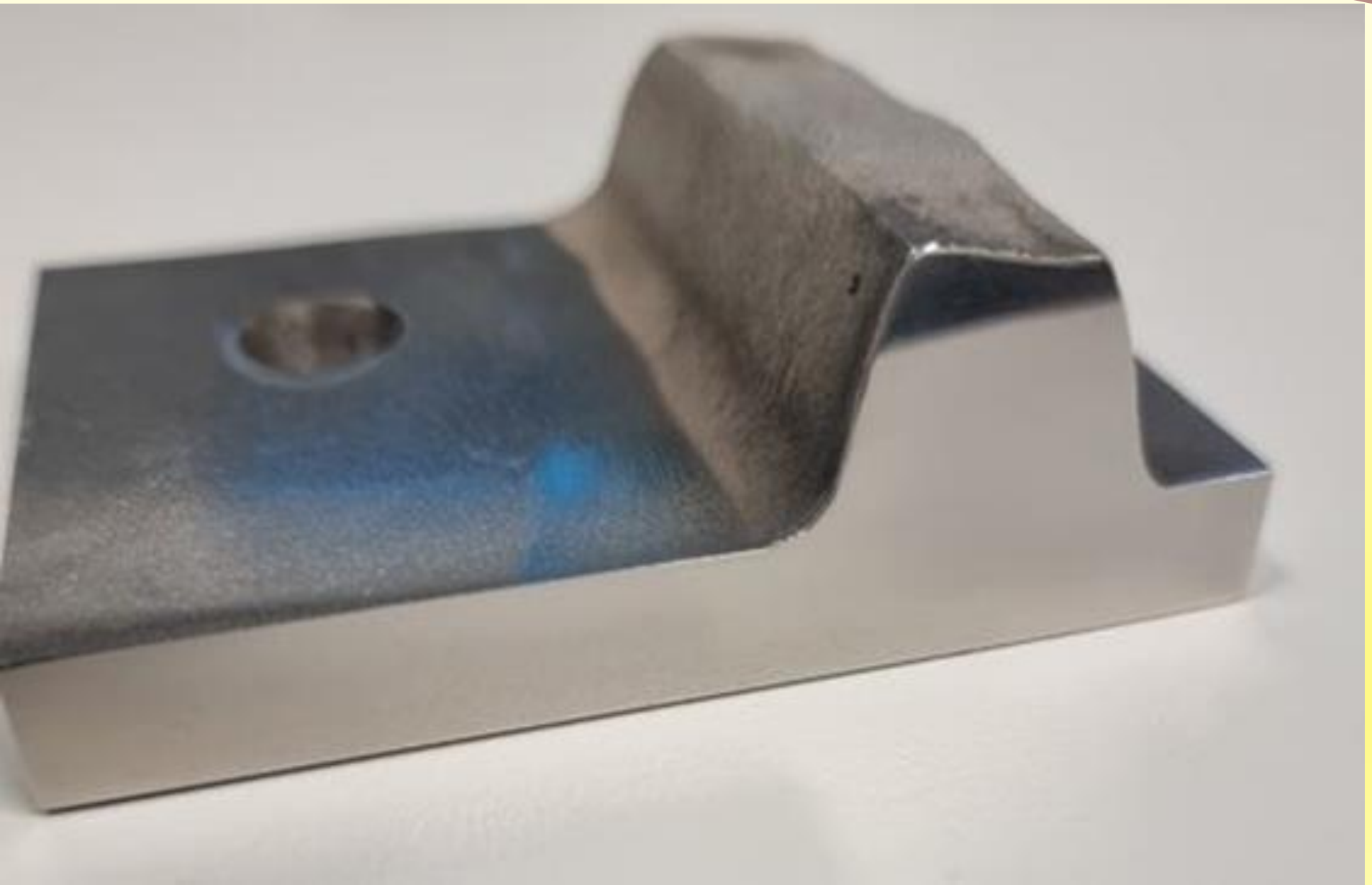
COLD SPRAY - Reparatur Alu

COLD SPRAY



In der fein geschliffenen Oberfläche sind die Cold Spray Bereich selten zu sehen.

Hier die aufgebrachte Rippe auf eine Platte

COLD SPRAY

Effective repair & maintenance of a 16V engine

Titomic cold spray was evaluated on the rebuild and long-life maintenance of a large-scale diesel engine. With numerous repairs made with cold spray, the engine was seen to be operating well after 24,000 hours of operation, with cold spray proving to be a competitive repair solution.

Crank case vapour passage repair

This section was originally repaired with metal epoxy, which quickly began to degrade after its 2,000 operational-hour rating. Titomic used a hard-wearing blend of Al, Zn, Al_2O_3 to repair the passage. Pictured on the right, there is no visible wear after 6,500 operating hours.

Faults in base material - epoxy repair

Resurfaced & repaired with D523

COLD SPRAY

Recontouring of camshaft bearing

This camshaft was repaired using the hand-held D523 system, depositing a 6mm layer of Al, Zn, Al_2O_3. The image on the left shows the cold spray repair after 12,600 hours, with the image on the right taken after 24,600 operating hours, showing no visible wear, deformation, or defects.

Cold spray repair after 12,600 hours

Cold spray repair after 24,600 hours

COLD SPRAY - Reparatur mobil

Luftdruck
oder
Stickstoff
min.
6 Bar
konstant
größerer
Vol.

---

elektr.
Strom
220V
10A

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COLD SPRAY - Reparatur Alu

COLD SPRAY - Reparatur Stahl

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COLD SPRAY - Felgenoberfläche

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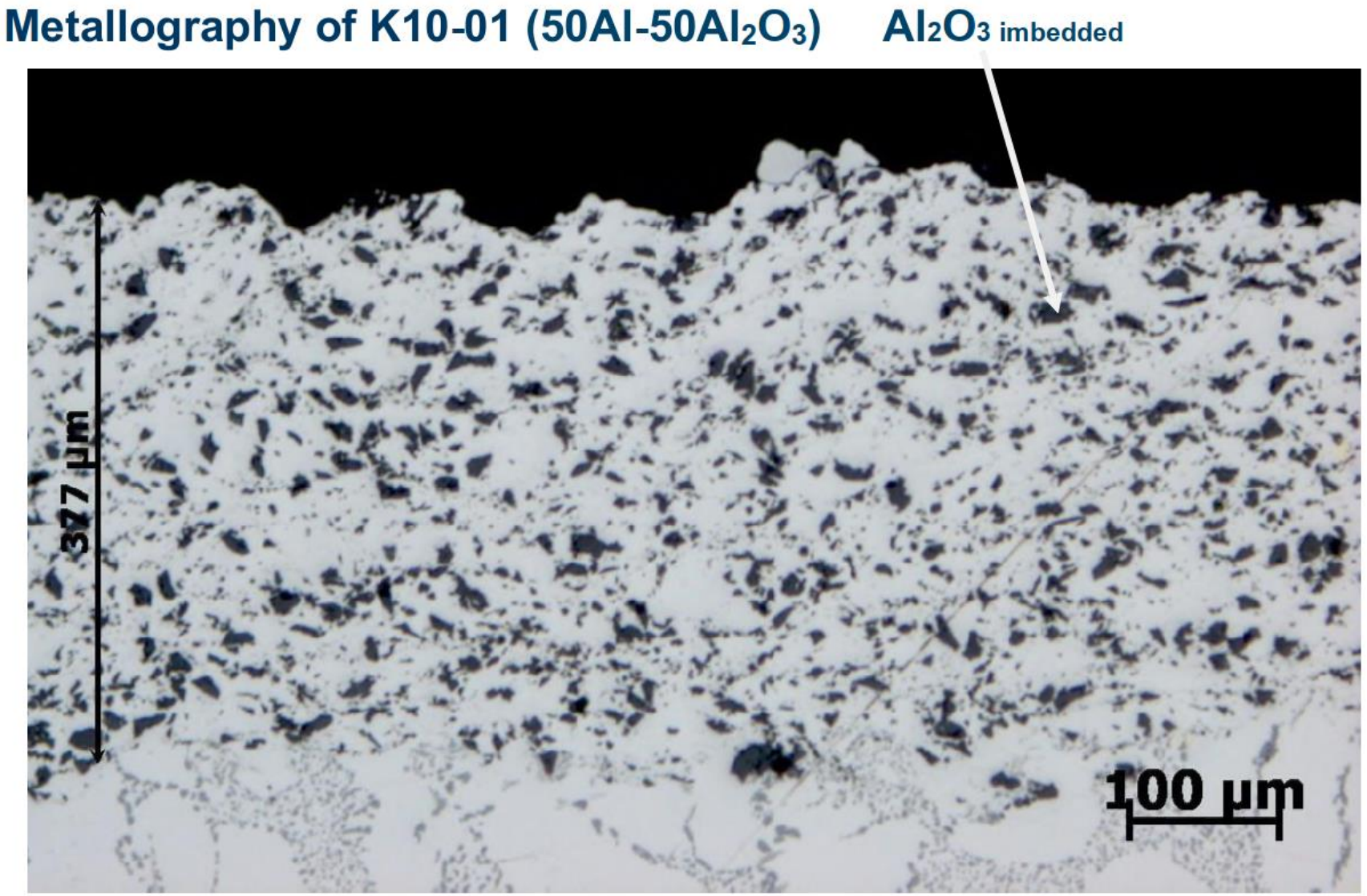
COLD SPRAY

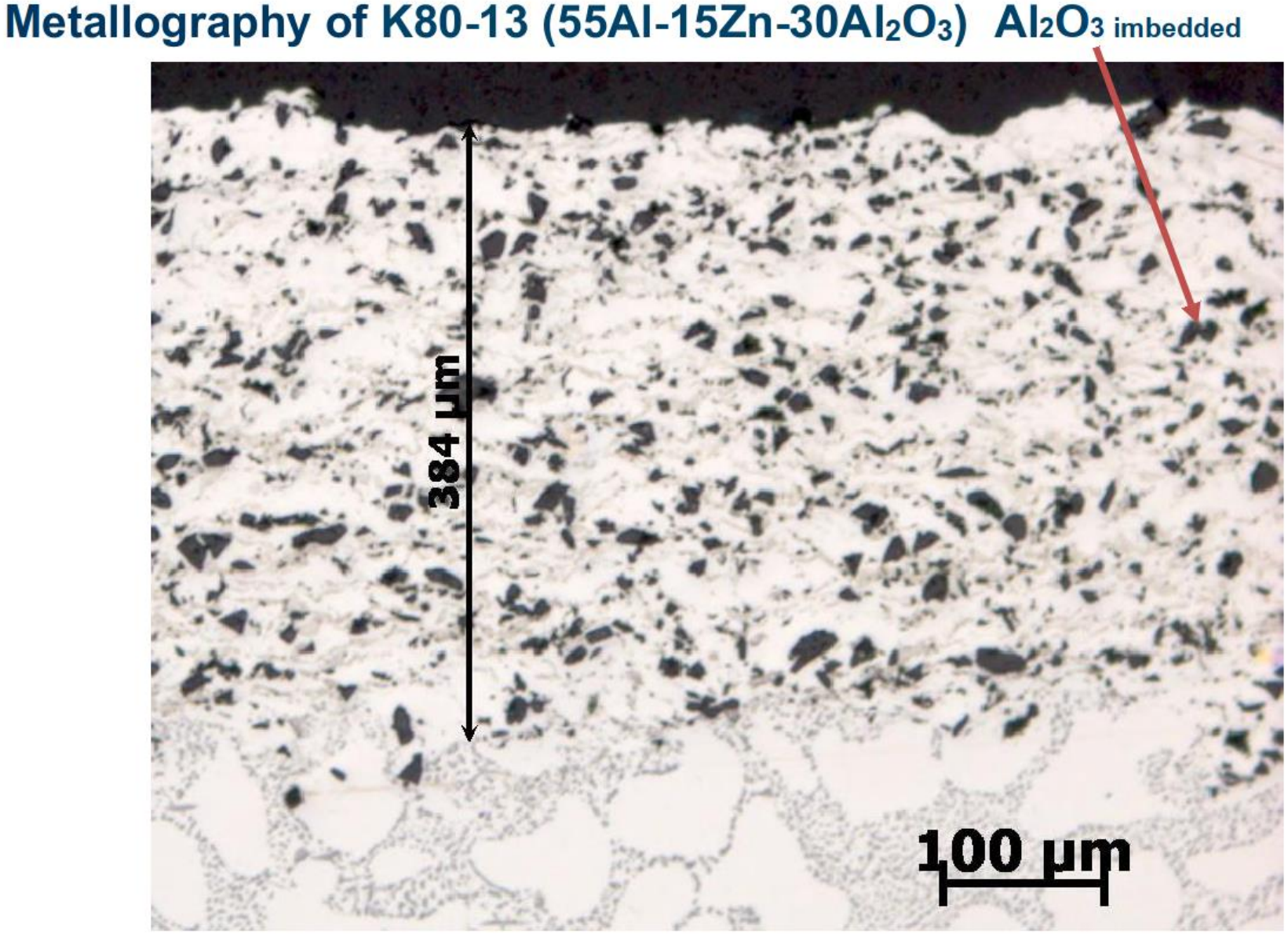
Low Pressure Cold Spray (LPCS)

- Compared to High Pressure Cold Spray (HPCS), particles have lower kinetic energy □ less suitable for high melting materials
- Very easy to use
- Suitable for manual coating application, but implementation in automated systems is also possible
- Needs only compressed air (6 bar) and electricity (220V, 3.3 kW)
- No masking necessary for many applications
- No aluminum oxide blasting necessary for many applications
- Bond strengths lower than with HPCS, but still significantly higher than Plasma and Wire Arc sprayed coatings

COLD SPRAY - Reparatur Alu



COLD SPRAY - Reparatur Alu



Corrosions-beständig

COLD SPRAY - Reparatur

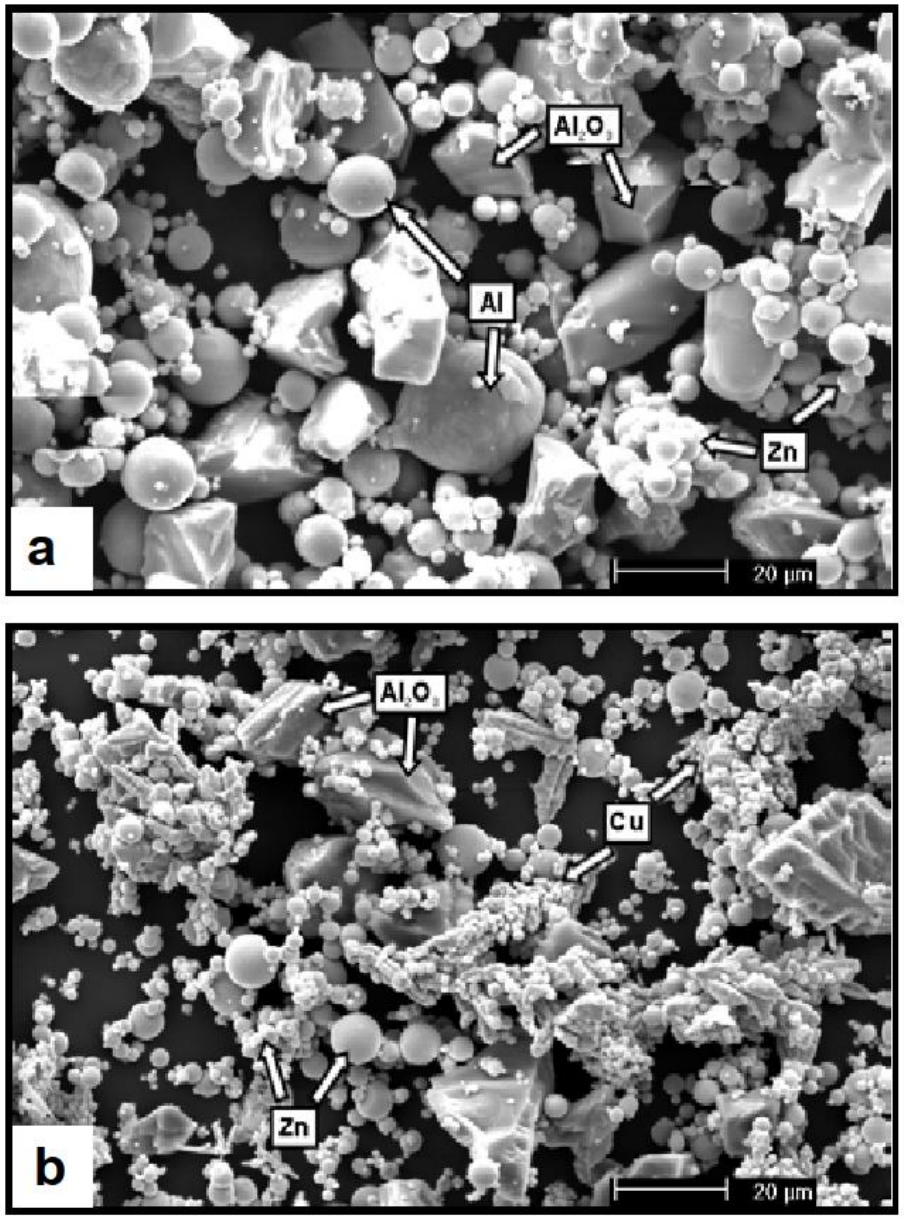


Fig. 1. Morphologies of powders a) $Zn+Al+Al_2O_3$, b) $Zn+Cu+Al_2O_3$ and c) $Zn+Ni+Al_2O_3$. SEM (SE) images.

COLD SPRAY - Reparatur Alu

Bond strength on aluminum test coupons

Coating	Process	Bond strength
PWA53-35 on PWA53-80 bond coat	Plasma	~40 MPa
PWA271-35 on PWA271-35 bond coat	Wire Arc	~30 MPa
K10-01, without grit blasting	LPCS	76,8 MPa
K10-01, with grit blasting	LPCS	78,7 MPa
K80-13, without grit blasting	LPCS	55,7 MPa
K80-13, with grit blasting	LPCS	58,4 MPa

Plasma and Wire Arc results are long term averages from our database, LPCS results are from individual sets of 3 test coupons each

- **Grit blasting before spraying has hardly any influence on bond strength of the tested LPCS coatings**
- **Application of bond coat is not necessary for achieving high bond strengths with the tested LPCS coatings**

COLD SPRAY - Reparatur Alu

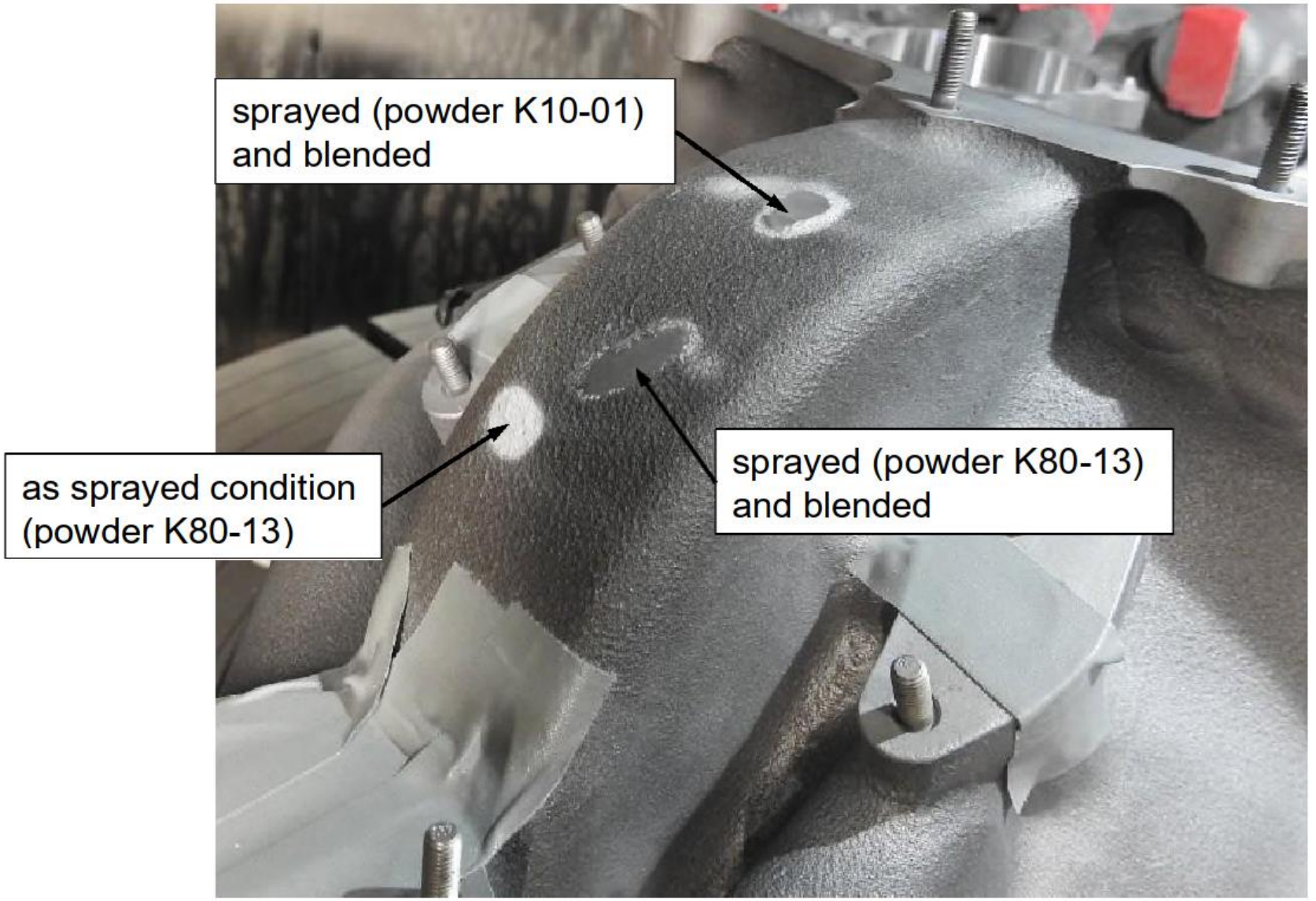
Micro hardness

Coating	Process	Hardness
PWA53-35 (Al-Si12)	Plasma	135 HV 0.1
PWA271-35 (Al-Si12)	Wire Arc	113 HV 0.1
K10-01 (50Al-50Al_2O_3) as sprayed	LPCS	75 HV 0.1
K80-13 (55Al-15Zn-30Al_2O_3) as sprayed	LPCS	71 HV 0.1
K10-01 (50Al-50Al_2O_3) machined	LPCS	107 HV 0.1
K80-13 (55Al-15Zn-30Al_2O_3) machined	LPCS	102 HV 0.1
Test coupon (XXX)	(base material)	78 HV 0.1
PW200 RGB Front Housing	(base material)	141 HV 0.1

- **Micro hardness of the LPCS coating is lower compared to the Plasma and Wire Arc ones**
- **LPCS coating becomes harder after machining, presumably because of a cold working effect**

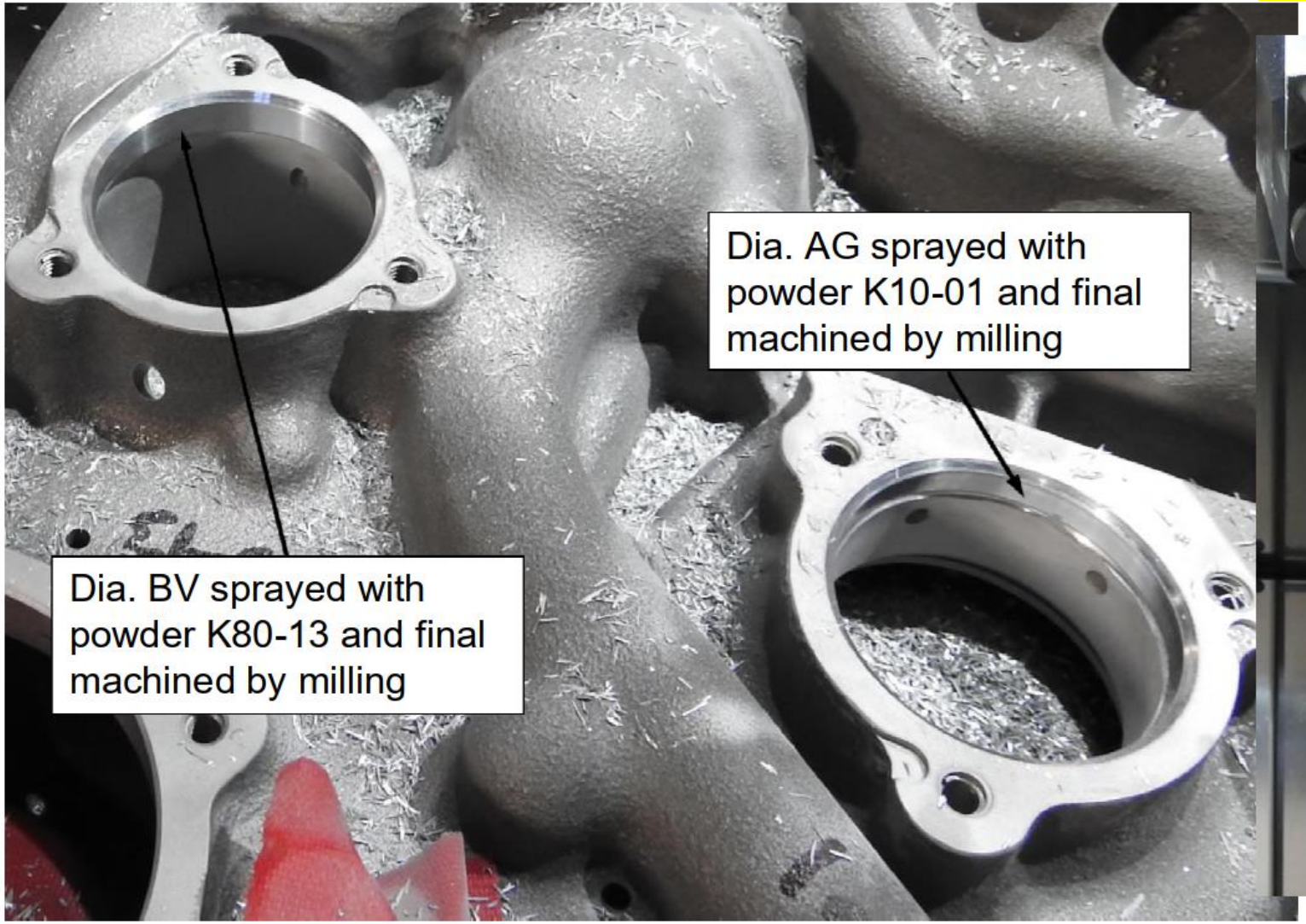
COLD SPRAY - Reparatur Alu

Potential use for spot repairs (replacing Epoxy repairs)



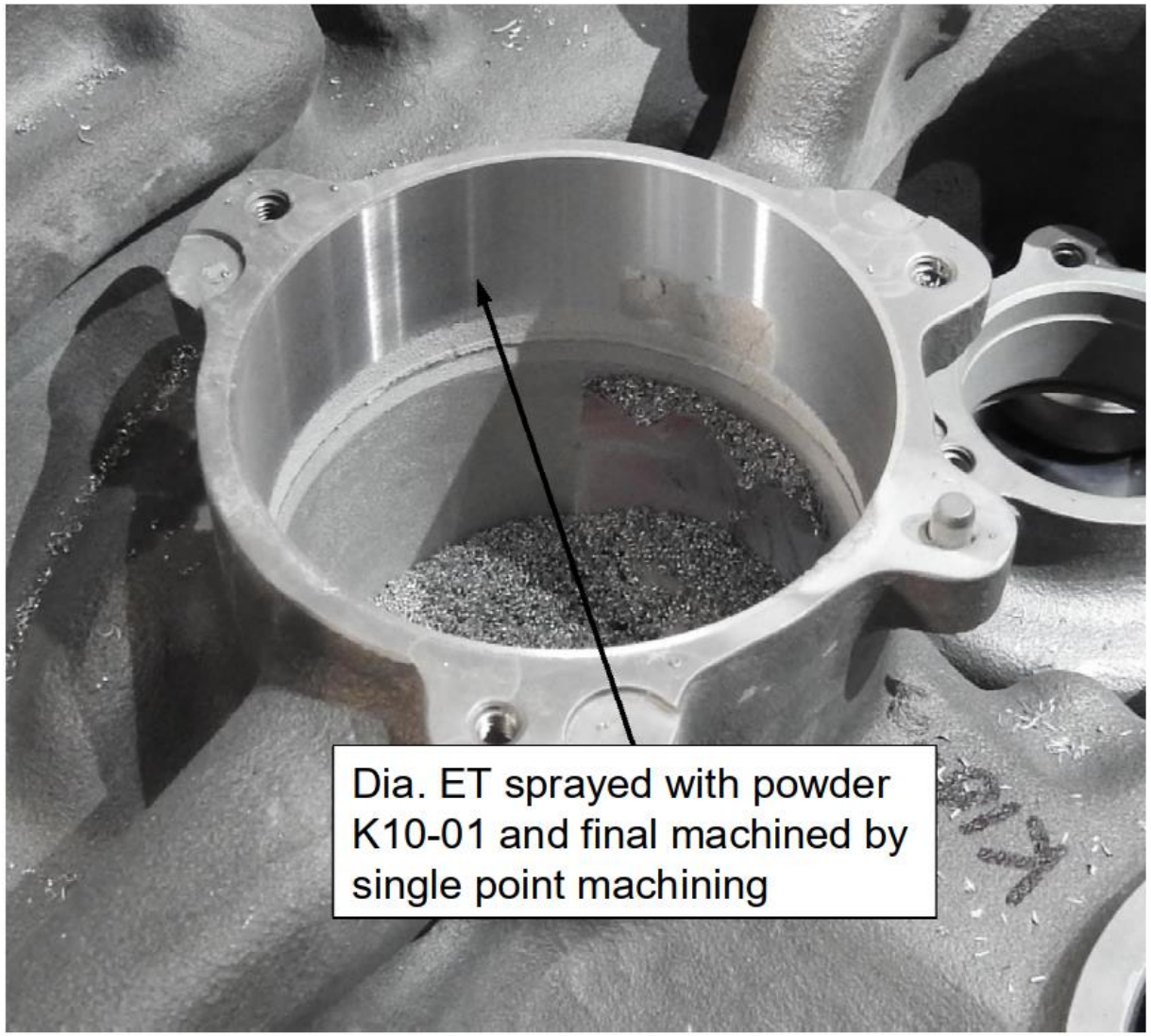
COLD SPRAY - Reparatur Alu

Potential use for dimensional restoration (replacing Laser repairs)

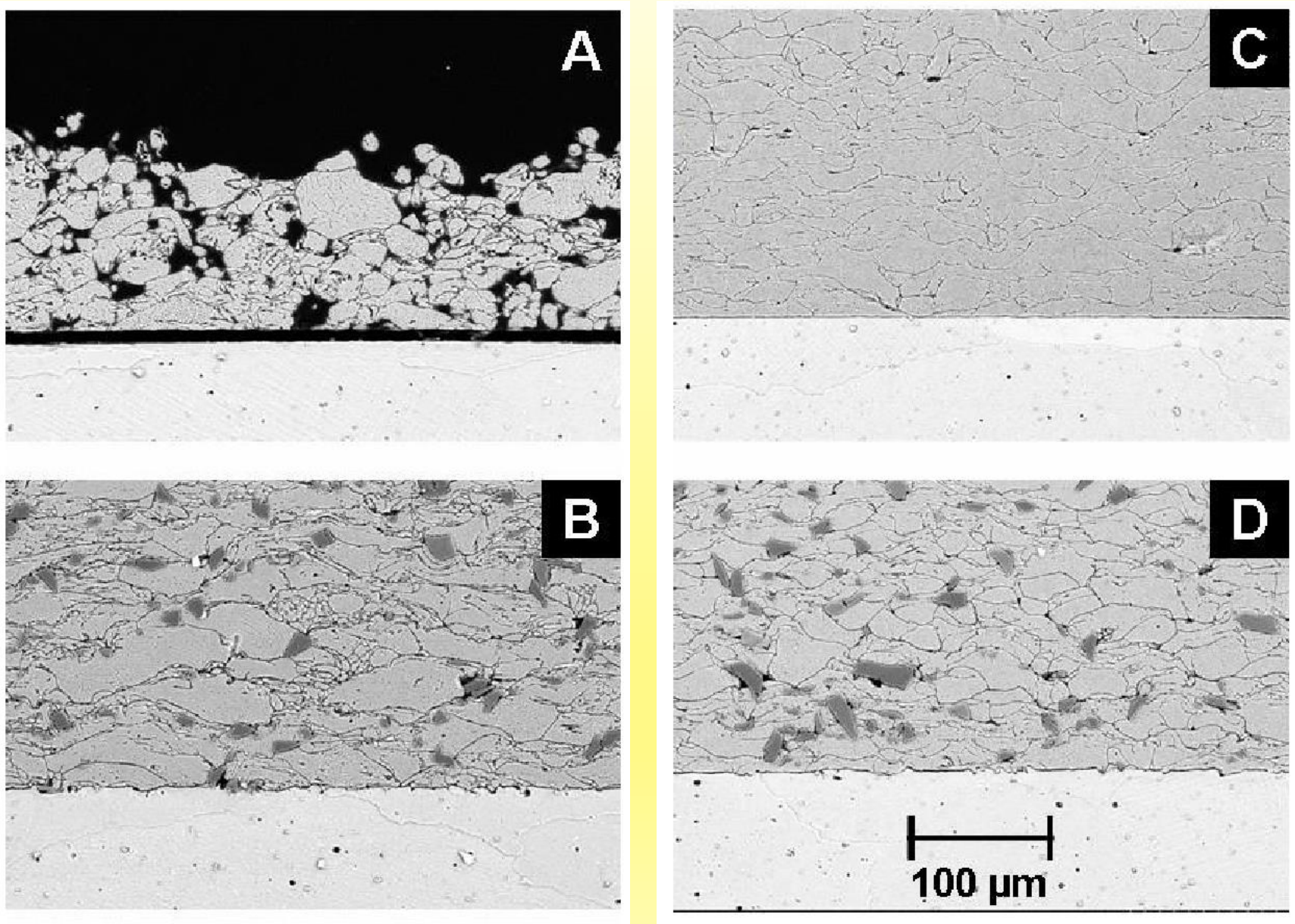


COLD SPRAY - Reparatur Alu

Potential use for dimensional restoration (replacing Plasma repairs)



COLD SPRAY - Reparatur Alu



Cross section back scattered elektron micrographs al etched cold spray coatings obtained with /A 54NS Al powder,
(B) 54NS+7wt.% Al2O3 powder mixture,
(C) Alfa Aesar Al powder and
(D) Alfa-Aesar AL+10wt.% Al2O3 powder mixture.

COLD SPRAY - Reparatur

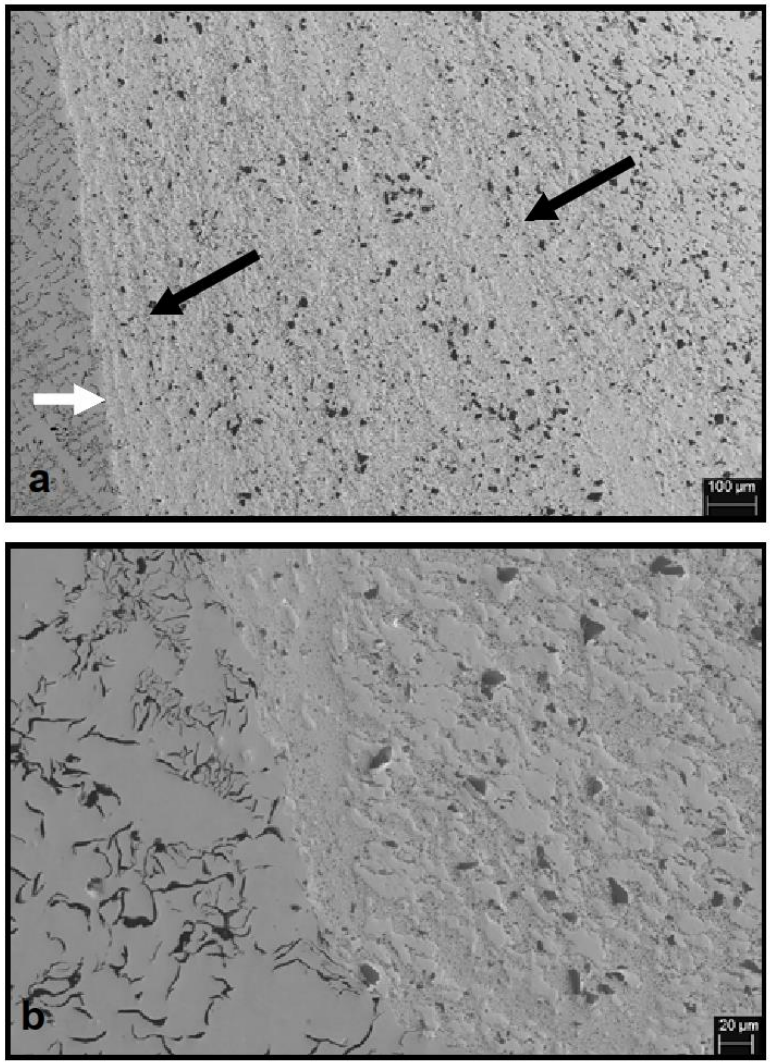


Fig. 7. LPCS Zn+Cu+Al_2O_3 coating. Cross-section of repaired part a) general (black arrows shows layered structure and white arrow coating-substrate interface) and b) detailed view. FESEM images.

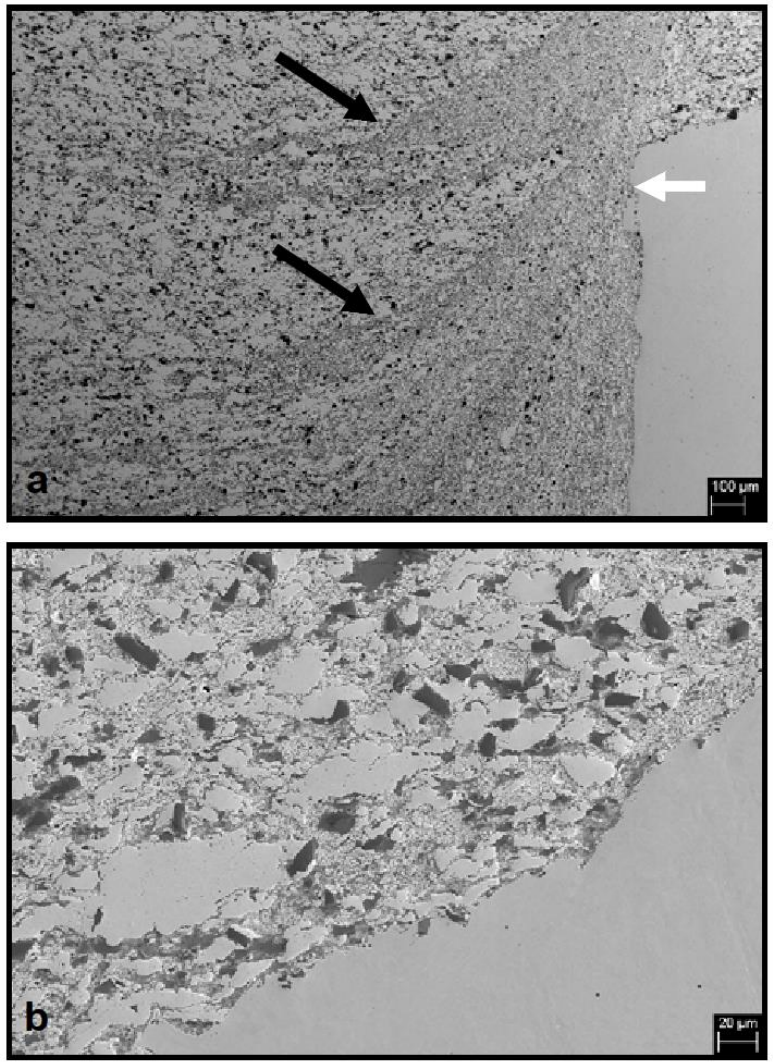


Fig. 9. LPCS Zn+Ni+Al_2O_3 coating. Cross-section of repaired part a) general (black arrows shows layered structure and white arrow coating-substrate interface) and b) detailed view. FESEM images.

COLD SPRAY - Reparatur

COLD SPRAY - Reparatur Eisenguss

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COLD SPRAY

	High Performance Nickel Based Alloy
UTS	690 Mpa
YTS	276 Mpa
Elongation	40%

Anwendungsbeispiel Kaltgasspritzen

Reparatur Pressenwerkzeug

unbearbeitete Schadstelle	nach dem Kaltgasspritzen	nach der mechanischen Bearbeitung
		
Die Schadstelle hat einen Durchmesser von ca. 3,0 mm und eine Tiefe von ca. 1,5 mm.	**Für die Reparatur mittels Kaltgasspritzen wurde die Auswahl des passenden Pulvers vorgenommen.**	**Um die Originalkontur des Bauteils wiederherzustellen, wurde eine mechanische Bearbeitung durchgeführt.**

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technical university dortmund
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VEGE
BAE SYSTEMS
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Technology and Service for engines and prime movers
coexpair
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OFFSHORE
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SHREE RAPID TECHNOLOGIES
Gallo Glass
california pure

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zertifiziert nach DIN EN ISO 9001:2015

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