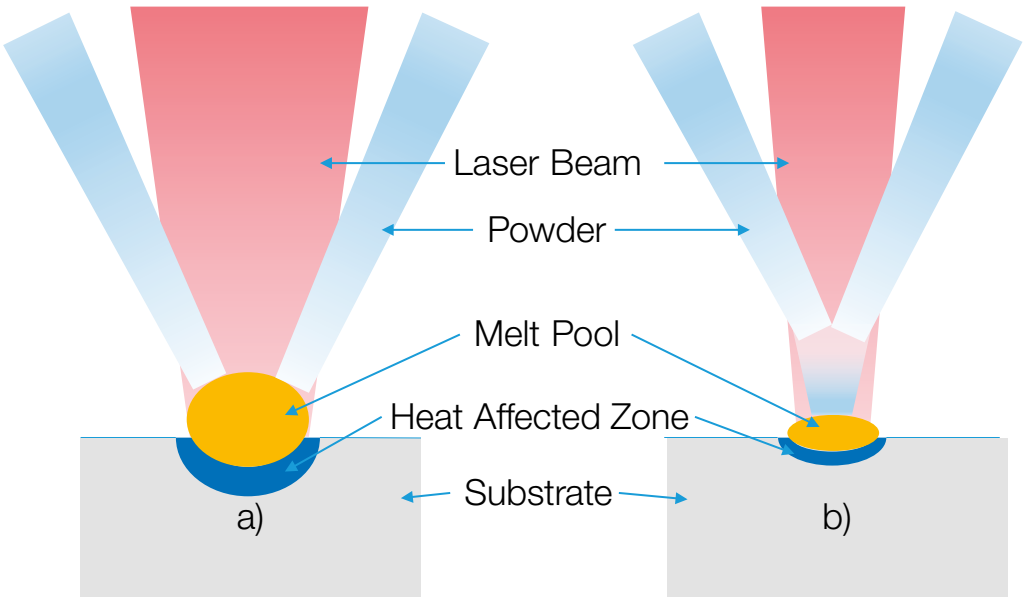
Technical Bulletin

High-Speed Laser Cladding – An Overview

Portfolio of materials tailored for highly efficient process capability



Basic principle of (a) conventional laser cladding and (b) high-speed laser cladding

Introduction

High-speed laser cladding (HSLC) is a further development of laser cladding with unique features compared to other deposition methods. HSLC guarantees metallurgical bonding with very low dilution (1–3%), high cladding speed (up to 300 m/min), a wide range of deposition thicknesses (50–500 µm per layer), and high deposition efficiency (up to 90%), all with an extremely low thermal input.

Typically, an area deposition rate of around 1 m^2/h is achieved for a layer thickness of 200 µm at a cladding speed of 100 m/min and with approximately 4 kW laser power. With an increase in available laser power, the area deposition rate can be linearly improved.

HSLC allows the deposition of coatings at much lower coating thickness compared to conventional laser cladding. Therefore, HSLC is a highly efficient coating technology, achieving more with less while retaining the advantages of dense and metallurgically bonded coatings. Unlike conventional laser cladding, in HSLC process, the laser power is mainly directed into melting the material, minimizing the heat-affected zone.

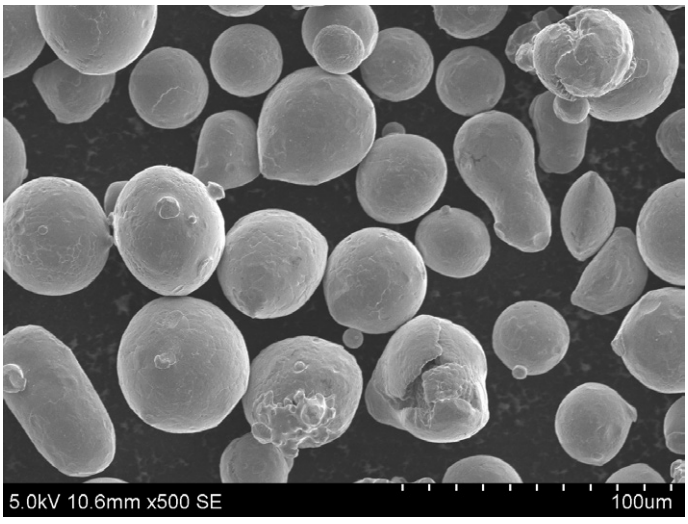
High-speed laser cladding process enables high-performance coating of various substrate materials, including steel, cast iron, aluminum, and bronze. This technology is suitable for metallurgically joined coatings onto thin walls and small mass substrates with extremely low thermal distortions. Multilayer deposition using HSLC technology is a feasible option when thicker coatings are required.

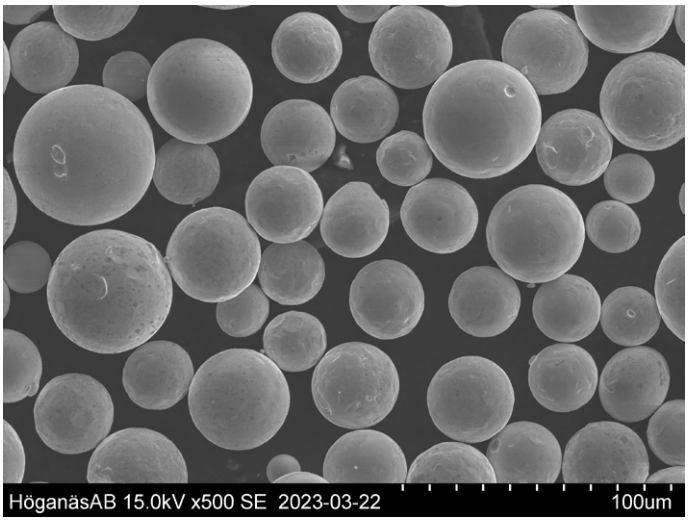
Powder Properties

Höganäs' high-speed laser cladding portfolio contains various grades of Fe-, Co-, and Ni-based alloys, with particle size & ranges selected to match specific equipment requirements.

The spherical powder morphology is optimized to ensure smooth flow as well as high deposition efficiency.

Figure 1: Typical Morphology of Fe-based and Ni-based Powders





Typical Properties of High-Speed Laser Cladding Coatings and Applications

Similar coating properties can be achieved with high-speed laser cladding as with conventional laser cladding, but with thinner coatings and consequently lower material consumption.

The data was collected through high-speed laser cladding on low Carbon substrates with a diameter of 50 mm. For 430L, tests were performed on lamellar cast iron discs. The laser beam spot size varied in the range of Ø1–2 mm, with cladding speed ranging from 30 to 100 m/min.

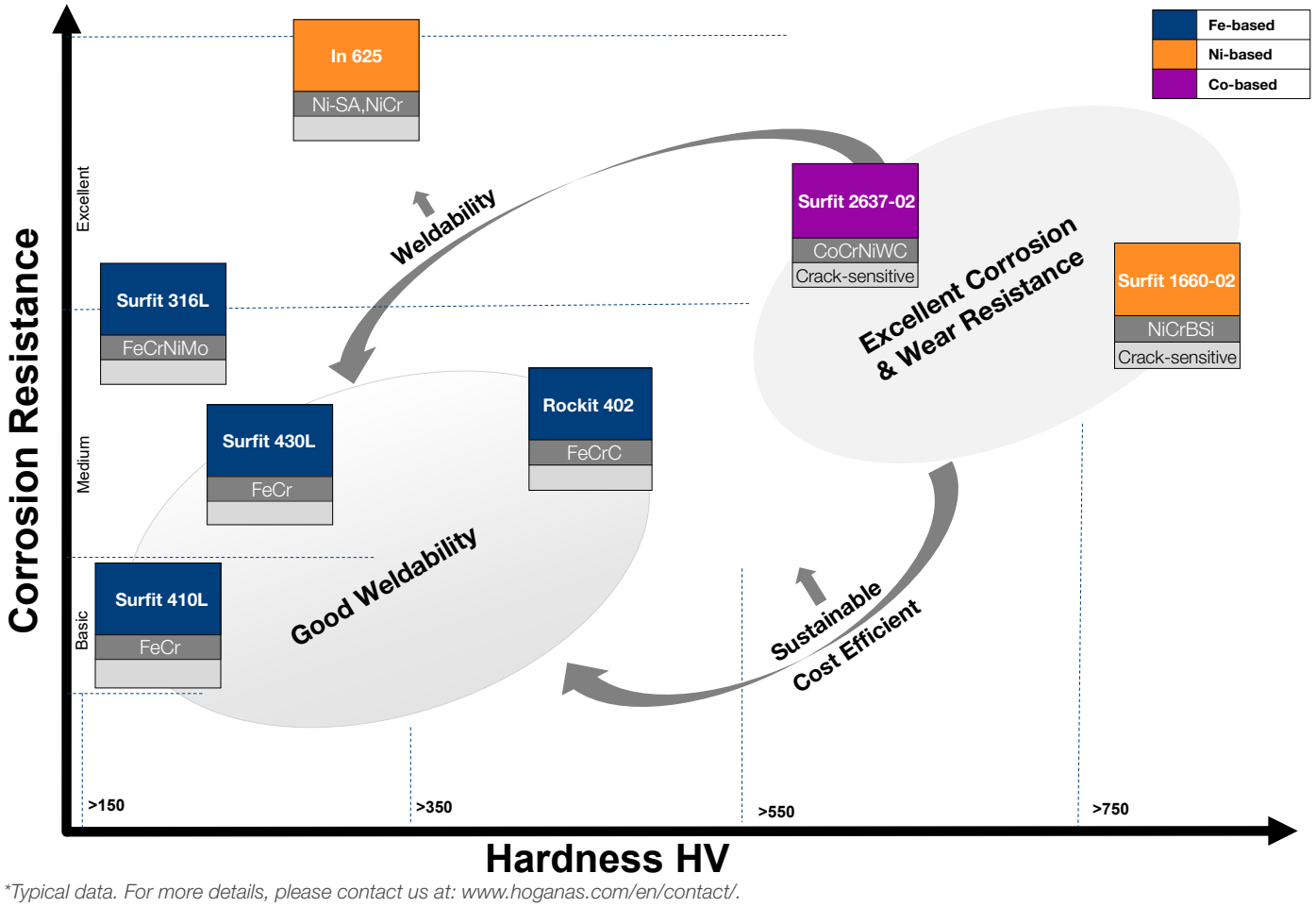
Typical applications where high-speed laser cladding has proven to be efficient include different types of hydraulic cylinders, where traditional hard Chrome plating could be replaced by Fe-based alloys. Geometries that can be rotated during cladding, such as cylinders, shafts, and brake discs, are generally suitable for this coating process.

Table 1: Overview of Höganäs' High-Speed Laser Cladding Portfolio

Product	Chemistry (wt%)								Hardness (HV0.2) at 30–100 m/min	Wear	Corrosion	Weldability	Special Features and Typical Applications
	Iron	Carbon	Silicon	Chromium	Nickel	Cobalt	Manganese	Other					
Surfit 316L 20-53µm	Bal.	Max 0.03	0.8	17.0	12.0	-	1.0	Mo=2.5	210	●	●●●●	●●●	• Good corrosion resistance as buffer/top layer
Surfit 410L 20-53µm	Bal.	0.03	0.5	12.5	-	-	0.1	-	210	●	●●	●●●●	• Cost-efficient corrosion-resistant buffer/final layer • Moderate corrosion protection • Can be cold-worked • Dimensional restoration of shafts and seats, bolts
Surfit 430L 20-53µm	Bal.	0.03	0.9	17.0	-	-	0.1	-	250	●	●●●	●●●●	• Cost-efficient corrosion-resistant buffer/final layer • Moderate corrosion protection • Can be cold-worked • Brake discs, dimensional restoration of shafts and seats, bolts, bond coat
Rockit 402 20-53µm	Bal	0.1	2.0	23.5	3.0			< 5	430	●●	●●●	●●●●	• Cost efficient top layer with medium corrosion protection and wear resistance • Good weldability • Hydraulic piston rods
In 625 20-53µm	1.4	Max 0.03	0.4	21.5	Bal.	-	-	Mo=9 Nb=3.65	310	●	●●●●●	●●●●	• Excellent corrosion protection
Surfit 1660-02 15-53µm	3.7	0.75	4.3	14.8	Bal.	-	-	B=3.1	880	●●●	●●●●	●●●	• Wear and corrosion resistance, high hardness • Hydraulic piston rods, pumps, sleeves, glass plungers
Surfit 2637-02 15-53µm	1.5	1.1	1.0	28.5	1.5	Bal.		W=4.4	620	●●●	●●●●	●●●	• Similar to Stellite™ alloy 6** • Corrosion and galling resistance • Valve seats, steam turbine shafts, general machine parts, with good all-around performance

**Typical data. For more details, please contact us at: www.hoganas.com/en/contact/*
***Registered trademark of Kennametall Stellite*

Figure 2: Qualitative Overview of Coating Properties for Corrosion and Wear with Fe-based (blue) and Ni-based (orange) and Co-based (purple) Materials



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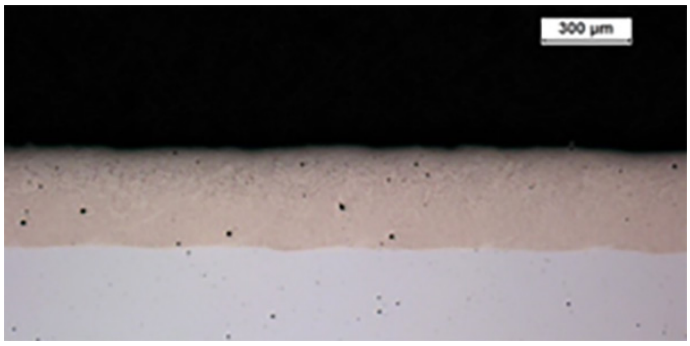
Höganäs ArcX Centers

To achieve optimal results, a process adjustment is required and can be supported by our experts at any of the ArcX centers around the world.

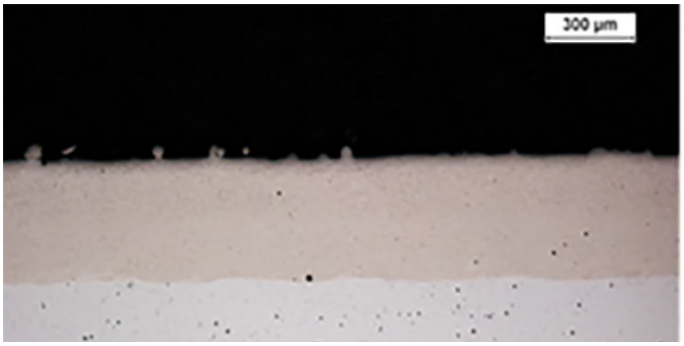
Coatings with smooth surfaces can be directly achieved through high-speed laser cladding (see Figure 3) without additional machining steps. Efficient material utilization and reduced machining lead to cost-effective coating solutions.

Figure 3: Examples of Coating Microstructures (LOM)

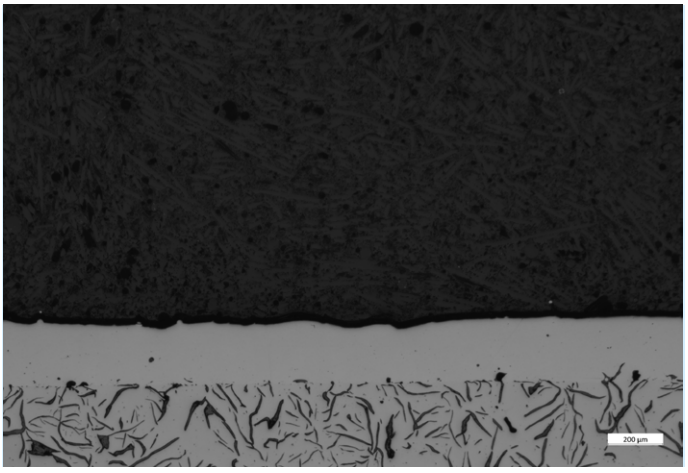
Efficient material utilization allows for cost-effective coatings, achieving more with less.



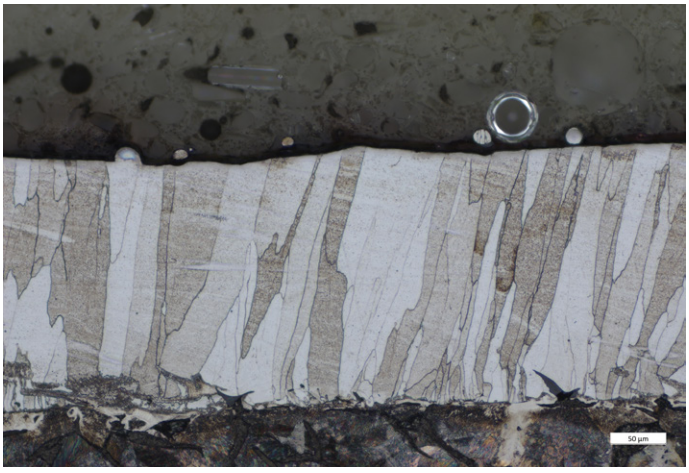
a) 1660-02 as coated at 30 m/min, as unetched



b) 1660-02 as coated at 100 m/min, as unetched



c) 430L as coated at 90 m/min, as unetched



d) 430L as coated at 90 m/min, etched in Vilella. Columnar ferrite grains.

Related Products

- To further boost wear resistance, various carbides can be admixed to Höganäs HSLC products.
- Coarser particle sizes of similar alloys are available from Höganäs for conventional laser cladding.

More info: scan or click the QR Code