DRIVING FREEDOM
OF MANUFACTURING

HUIRUI

NANJING HUIRUI PHOTOELECTRIC TECHNOLOGY CO., LTD.

Inquiry：+86-25-8675 6108

After-sales：+86-25-8675 6109

E-mail：info@huirui-tech.com

Website：www.huirui-tech.com

Facebook:@Hui Rui

Twitter:@HuiRuiTech

VK:@Hui Rui-Tech

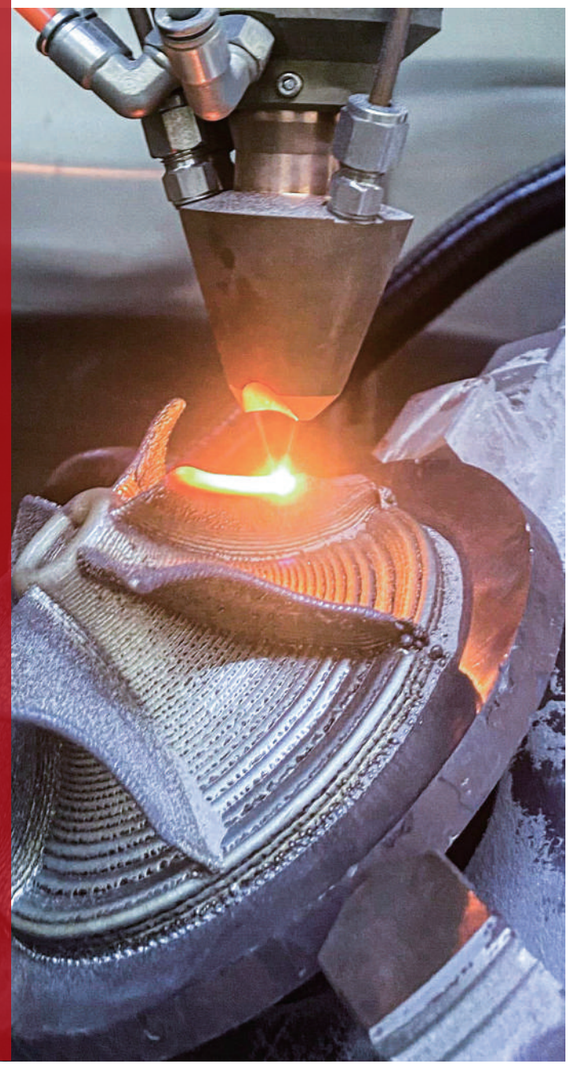
YouTube:@HuiRui-tech

Address：No1 Ruixin Road, Jiangning District, Nanjing, JiangSu, China

HUIRUI

HUIRUI GROUP

PROVIDE COMPLETE SOLUTIONS FOR ADDITIVE MANUFACTURING HIGH PERFORMANCE METAL PARTS



HUIRUI’s vision

Driving freedom of manufacturing

Becoming one of the most influential global intelligent manufacturing enterprise

HUIRUI’s Mission

To provide professional, high-quality products and service for customers

To satisfy customer’s high value demands for advanced manufacturing technology

To establish an efficient value-creating platform for HUIRUI employee

HUIRUI’s values

Practical Excellent Wise Innovative

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ABOUT HUIRUI

Founded in 2015, Huirui Group is a Chinese national high-tech enterprise headquartered in Nanjing Jiangsu Province, China. We are committed to the development of green and intelligent laser metal additive manufacturing technology in various industrial applications, providing our clients with customised equipments and service for rapid manufacturing and additive repair of high-performance metal components.

◎ Technical Advantages

Our technical team has long been dedicating in the development and applications of laser metal additive manufacturing technology. Our complete solution of laser additive manufacturing system has successfully provided coating repair service to high value metal parts from various industries, such as hydropower, aeroengine, steel mill and mining machinery. A large database of laser powder deposition process with various high-performance alloys has been established based on a vast of application needs from many different industrial fields.





◎ Qualifications & Honors (Parts)

Huirui's laser cladding equipment and powder feeder have passed CE certification, which is in linewith international, European and American standards.

◎ Intellectual Property

Huirui and its subsidiaries have accumulatedand applied for more than 200 independent intellectual proprirtary rights including 50+invention patents, 100+ utility model patents and appearance patents, and is the owner of 20+ software registration copyrights.

Company Milestones

2012

2013

- Shanghai Caishi Laser Technology Co. was founded;
- The first robot-based laser net shape repair system iLAM1000 wasinvented and built(patent no.CN201520275318.0).

2014

- Version 1.0 alpha of computer-aided additive manufacturing CAAM software was released;
- The additive repair process for high performance turbine blades developed by Huirui passed the engine test.

2015

- Robot laser cladding equipment iLAM1005 was successfully developed and delivered for production;
- Chengdu Qingshi Laser Technology Co. was established.

2016

- Huirui headquarter was established in Nanjing, China;
- Huirui's first patent "Net Shape Repair System" was authorized.

2017

- Huirui R&D Centre was established in Hangzhou, China.

2018

- Huirui Zhuzhou Additive Manufacturing Technology Co. was established;
- Huirui Nanjing was certified for"ISO9001" standard.

2019

- The first 5-axis NC based laser cladding system, Metal+®505C, was successfully developed;
- Huirui's second-generation mobile cladding machine, MobiMRO®, was successfully developed.

2020

- Huirui's second-generation ultra-high-speed laser cladding equipment was successfully developed and delivered for production.

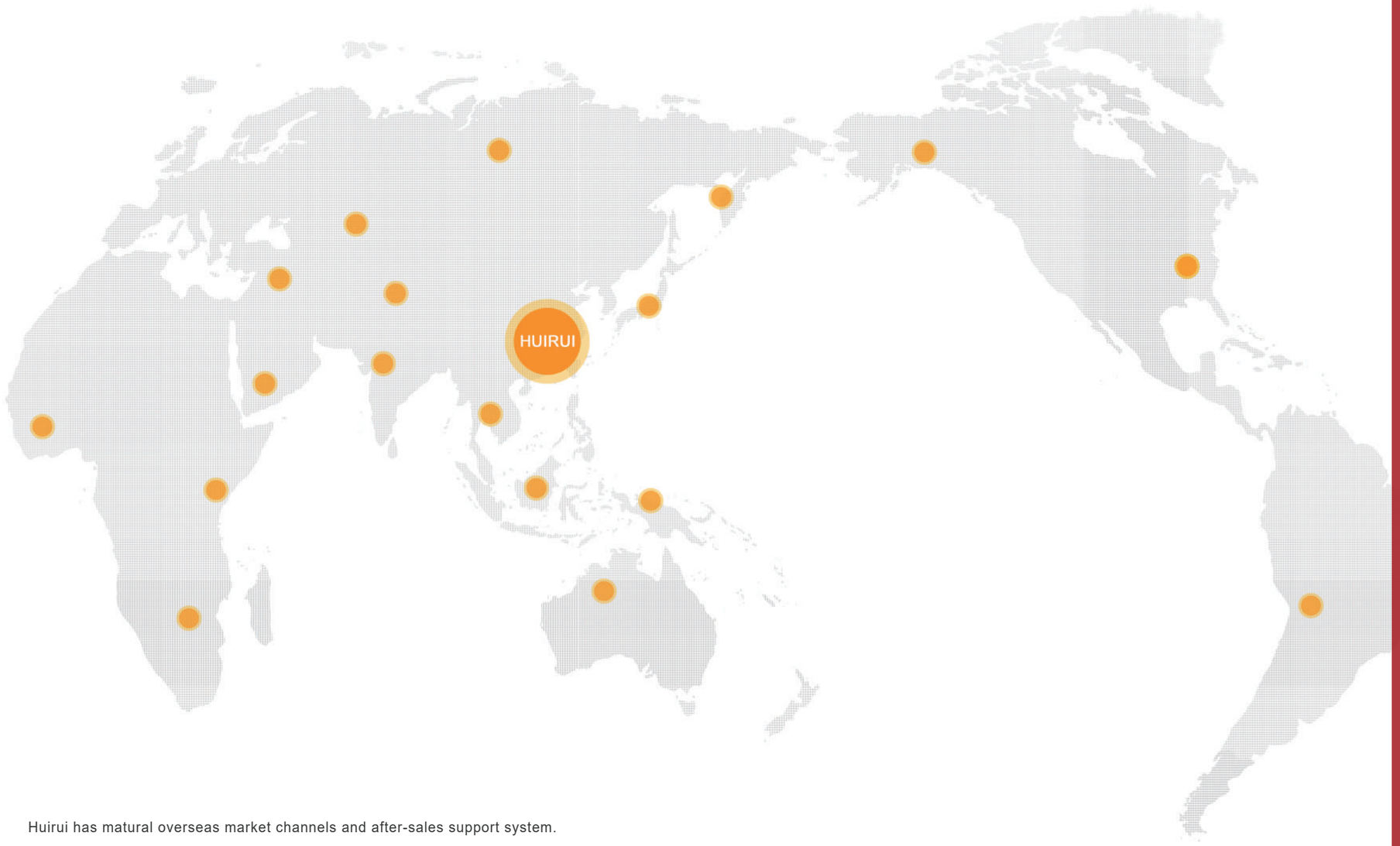
2021

- Huirui Tianjin was established.

2022

- Huirui Shanxi and Huirui Zhengzhou were established;
- Huirui cladding head was awarded the "Red Light Award" for laser processing head innovation and contribution.
- Huirui high-throughput material 3D printing equipment Metal+ 0ne was successfully developed.

◎ Business Affiliations



Huirui has matural overseas market channels and after-sales support system.
Our professional maintenance engineers who can provide oversea customers
with after-sales support services in a timely and effective manner.
Up to now, Huirui has served more than 500 customers all over the world.


Huirui Nanjing(HQ)


Huirui Chengdu Qingshi


Huirui Tianjing


Huirui Zhuzhou


Huirui Zhengzhou


Huirui Hangzhou


Huirui Shanxi

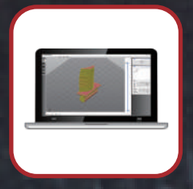
Huirui Shanghai

LASER INTELLIGENT MANUFACTURING SYSTEM

INTEGRATING FIVE KEY TECHNOLOGIES

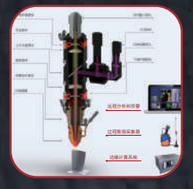
Laser Technology

Robot and CNC



Computer-aided Design &Manufacturing

Material Processing Technology



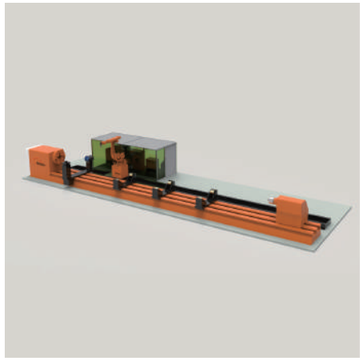
Optical Sensing & FeedbackControl Technology

iLAM® Series

Intelligent Laser Additive Manufacturing System

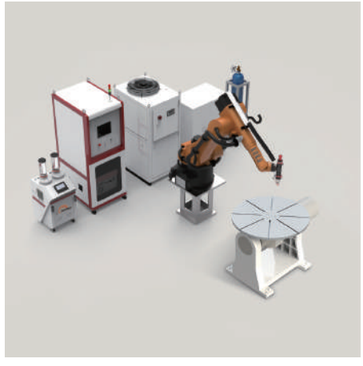
Inert Chamber iLAM

Equipped with positioner, 8-axis robotic intelligent laser additive manufacturing system for net-shape additive repair of high performance part and 3D printing new products with controled oxygen and moisture environment.Capble processing Titanium,Aluminium, Nickel-based superalloys.



Translation Robot iLAM

Laser cladding for long axle/shaft surface coating and repair with robot slide up to 10m, ultra-high speed coating to replace Chrome plating, environment friendly and high efficiency.



Robot Workstation iLAM

8-axis robots laser cladding system for non-standard parts can be adapted to complex structures and non-standard parts. For complex geometry cladding processing and surface treatment of different types of workpieces.

Metal+® Series

For Metal 3D Printing Directed Energy Deposition(DED) System

High-throughput Metal 3D Printing DED

Atmosphere protected 3-axis laser addtive system can realize the preparation and printing of continuously-changing metal composition materials.It is mainly used in 3D printing, additive repair, cladding strengthening, material design research, etc.

Standard 5-axis NC DED

This system is professionally customized according to the actual needs of customers, taking into account both repair and 3D printing purposes; It can be used for batch production, and lean production manufacturing needs.

Metal+One®

3D printing high-throughput material equipment that is compact in size, refined and accurate powder feed, especially for use in material design research and laboratory environments.

UHS-iCoating® Series

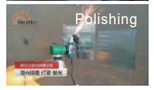
Ultra-high-speed Laser Cladding System

- High processing efficiency
- Stable coating process
- Multi-speed adjustable
- Hydraulic tailstock jack

Device model	C634	C636	C636A
Laser	Fiber/Diode laser source Laser		
Laser power	≤12kW		
Spindle speed	1-200rpm	1-150rpm	
Motion mechanism	3+1Axis		
Deposition efficiency	≤500cm² /min		
Repeat position accuracy	±0.05mm		
layer thickness	50–1500μm		
Processing length	3m		
Weight capacity	2t	3t	
Chuck diameter	320mm	500mm	
Maximum rotation diameter	400mm	600mm	
Substrate dilution rate	＜1%		
Maximum diameter of workpiece	400mm	600mm	
Maximum length of work piece	3000mm		

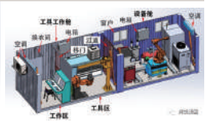
MobiMRO® Series

Mobile Laser Cladding Additive Repair System



Mobile Laser Cladding And Grinding System

To reduce the MRO response time for customer needs, the components required for laser cladding are integrated into modules, with a special transport vehicle. The equipment can be quickly delivered to the repair site, it can be quickly assembled for the cladding operation. Saving customers time and costs while improving integity of repaired parts.

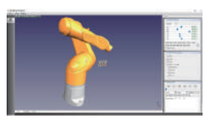


Mobile Laser Additive Repair Workstation

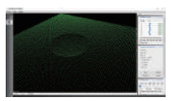
1.Humane friendly overall space layout;
2.Compartment design to facilitate the operation, maintenance and inspection compartment;
3.Equipped with process monitoring devices.

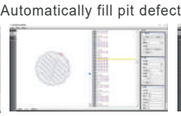
◎ Robot Adaptive Teching Measure And Toolpath Generation

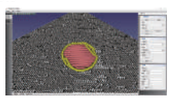
Scan measurement ➡ Teaching point generation ➡ Robot path generation ➡ Perform cladding



Automatically fill pit defects



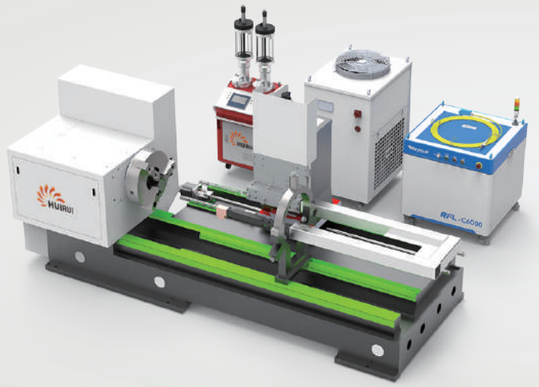




1.Laser displacement sensor measures and automatically teaches and generates processing paths;
2.Saving most of the manual teaching time;
3.Establish workpiece coordinate system, compensate original processing path, and three-dimensional modeling.

ID Cladding Series

Inner Diameter Laser Cladding System

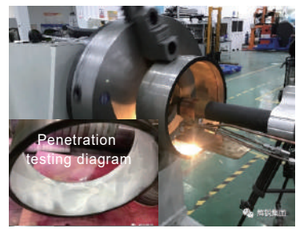


- ◎ Small heat affected zone;
- ◎ Smooth cladding surface;
- ◎ Shallow melting depth, the low dilution;
- ◎ For cladding of a variety of materials;
- ◎ High integration,precision and adaptability.

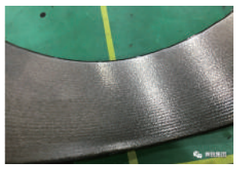
Laser power	up to 10kW	Cladding efficiency	1.0m²/h
Powder size	25–150μm	Powder feeding amount	0.1-200g/min
Spindle speed	0.5-50rpm	Cladding thickness	0.3-1mm

◎ Cladding Thickness

The thickness of the cladding layer is 0.3-0.6mm. The surface of the cladding layer is continuousand uniform, no pore defects are found.



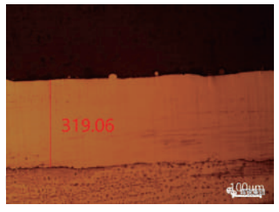
Cylinder liner cladding repair



Penetration inspection of the inner hole cladding layer showed no crack defect

◎ Metallographic Inspection

The cladding layer and the base material are metallurgically bonded. No crack,pore and dilamination defects.



Metallographic diagram

◎ Salt Spray Corrosion Test

After 1000 hours of continuous nutralsalt spraying, the surface corrosion of the cladding examined. There are no rust spots on the surface of the cladding layer is found.

Salt spray test 1000h

Laser DED Components

Laser Head

Laser Processing Head Innovation Redlight Award

Huirui's laser cladding head can be used for various application scenarios. Diversified modules configurations and interface settings are compatible to various lasers and cladding needs achieving efficient and stable long-term operations.

- Laser-grade optical modular design;
- Precise adjustable tocal point and spot sizes;
- ID 65 and shock-proof seal design for robust operation.

Model	LH-ZSR-1020	LH-ZVR-1020	LH-WSR-1020	LH-WVR-1020
Optical path structure	Straight		Bent	
Beam splitter module	None	Yes	None	Yes
Applicable wavelength	900-1100nm			
Maximum applicable power	8kW			
Laser energy pass rate	＞99.5%@900-1100nm wavelength			
Optical fiber interface	QBH，LLK-B/D，QD			
Optical path coaxial adjustment	X-Y direction adjustable precisely			
Collimation distance	100mm/150mm			
Focus distance	200mm/300mm/400mm			
Circular spot output size	0.5-5.0mm			
Focal postion adjustable	Yes (manual)			
Focus adjustable range	±5mm			
Coaxial Imaging module	None	Yes	None	Yes
Camera	None	CCD/CMOS	None	CCD/CMOS
Linear spot	Available			
Lighting module	Available			
Linear spot size	8X2mm/10X2mm/12X2mm/16X2.5mm/20X2mm/30X2mm			
Overall size(mm)	122X102X364	200X102X364	309X102X258	309X102X258
Overall weight	4.5kg	5kg	6kg	6.5kg

Laser DED Components

Laser Head

Coaxial Linear Spot Cladding Head

Model:D5WL

Applicable wavelength:

900-1100nm

Power:≤8kW

Collimation distance:

100/150mm

Focus distance:300/400mm

Rectangular spot size:

10X2/16X2.5/20X2mm

Off-axis Linear Spot Cladding Head

Model:D5WL

Applicable wavelength:

900-1100nm

Power:≤8kW

Collimation distance:

100/150mm

Focus distance:300/400mm

Rectangular spot size:

10X2m/16X2.5/20X2mm

Off-axis Linear Spot Cladding Head

Model:D52ZL

Applicable wavelength:

900-1100nm

Power:≤12kW

Collimation distance:

100/150mm

Focus distance:300/400mm

Rectangular spot size:

20X2/30X2mm

Internal Hole Cladding Head

Model:D80

Collimation distance:50mm

Focus distance:100mm

Beam spot:2-3mm

Power:≤2kW

Depth:≤300mm

ID:≥80mm

Internal Hole Cladding Head

Model:D100

Collimation distance:50mm

Focus distance:100mm

Working distance:10-12mm

Beam spot:2-3mm

Power:≤3.5kW

Depth:≤500mm

ID:≥100mm

Internal Hole Cladding Head

Model:D180

Collimation distance:50mm

Focus distance:150mm

Beam spot:2-3mm

Power:≤3.5kW

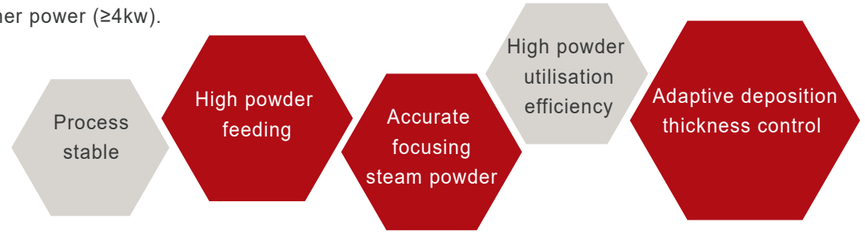
Depth:≤2m

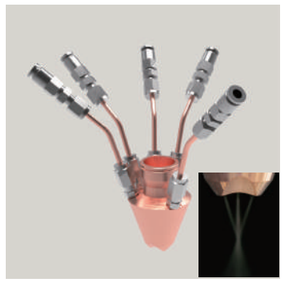
ID:≥180mm

Laser DED Components

Cladding Nozzle

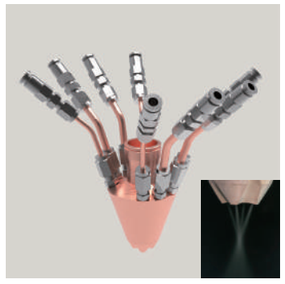
Huirui has developed a variety of laser cladding nozzles. The nozzles are interchangeable and can be fitted with Huirui's laser heads by the same nozzle interface module. The linear nozzles can be used in combination with the shaping module to produce a linear-shaped spot, which meets the need for efficient and long-lasting cladding at higher power (≥4kw).





3-point Nozzle

Specification:CT-1317-01
Laser power:≤4kW
Working distance:16-18mm
Powder spot size:2-3.5mm
Aperture:φ6.5mm
Powder particle size:50-200um
Powder flow:3-25g/min



4-point Nozzle

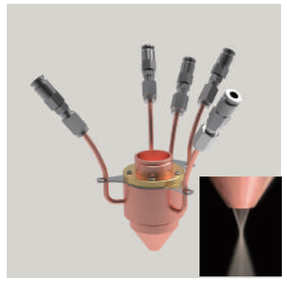
Specification:CT-1317-01
Laser power:≤6kW
Working distance:16-18mm
Powder spot size:2.5-4mm
Aperture:φ7.5mm
Powder particle size:50-200um
Powder flow:10-100g/min

Long Focal 4-point Nozzle

Specification:CT-1330-01
Laser power:≤6kW
Working distance:30-32mm
Powder spot size:3.5-5.5mm
aperture:φ7.5mm
Powder particle size:50-200um
Powder flow:10-100g/min

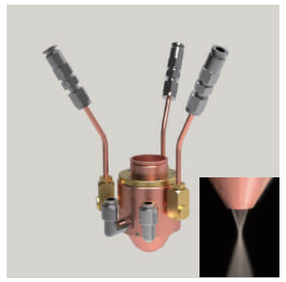
Laser DED Component

Cladding Nozzle



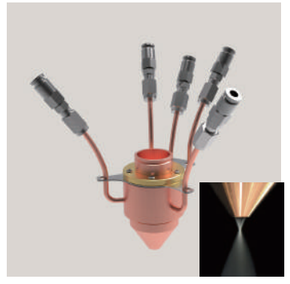
Long Focal Ultra-high Speed Cladding Coaxial Nozzle

Specification:CT-0610-01
Laser power:≤5kW
Working distance:9-13mm
Powder spot size:0.8-1.5mm
Aperture:φ6mm
Powder particle size:25-150um
Powder flow:1-45g/min



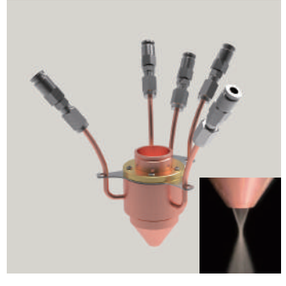
Strong Chilling Coaxial Nozzle

Specification:CT-0715-01
Laser power:≤6kW
Working distance:15-17mm
Powder spot size:2-3.5mm
Aperture:φ7mm
Powder particle size:50-150um
Powder flow:1-45g/min



Short Focal Ultra-high Speed Cladding Coaxial Nozzle

Specification:CC-0406-01
Laser power:≤3kW
Working distance:6-7mm
Powder spot size:0.6-1mm
Aperture:φ4.3mm
Powder particle size:50-150um
Powder flow:1-45g/min

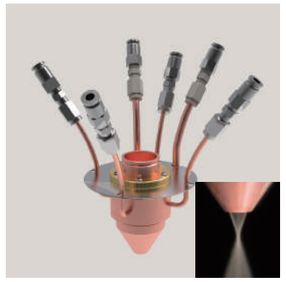


Ultra-high-speed Cladding Coaxial Nozzle

Specification:CC-0408-01
Laser power:≤3kW
Working distance:7-9mm
Powder spot size:0.8-1.5mm
Aperture:φ4.2mm
Powder particle size:25-150um
Powder flow:1-45g/min

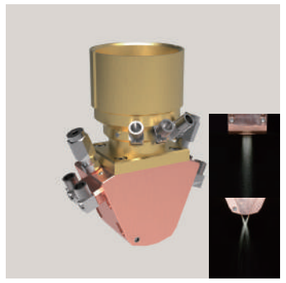
Laser DED Component

Cladding Nozzle



Long Focal Coaxial Annular Nozzle

Specification:CC-7520-02
Laser power:≤8kW
Powder spot size:1.5-2.5mm
Powder particle size:53-150um
Powder flow:1-45g/min
Working distance:19-23mm
Powder flow shape:annular-shaped

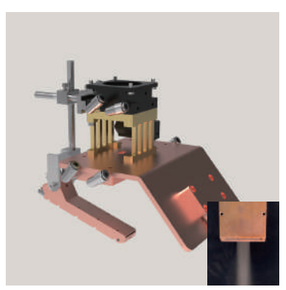


Coaxial Linear Nozzle

Specification:CC-1012(10-15)-01
Laser power:3-10kW
Linear Powder Flow Length:6-24mm
Linear powder flow width:2-4mm
Powder particle size:50-200um
Powder flow:30-200g/min
Working distance:12.2mm

Off-axis Single-point Nozzle (Round Spot)

Specification:SO Series
Laser power:≤6kW
Minimum powder feeding diameter:1.5-2mm
Powder particle size:50-200um
Working distance:10-15mm



Off-axis Linear Nozzle (Linear Spot)

Specification:SL Series
Laser power:≤6kW
Minimum powder feeding diameter:1.5-2mm
Powder particle size:50-200um
Working distance:10-15mm

Laser DED Component

Powder Feeder

Huirui's full range of powder feeder,can achieve long-distance powder conveying, its stable and high precision powder feeding, help customers to achieve stable and leam.

- High-precision powder feeding;
- Synchronized to laser process;
- Various powder hollor configurations;
- Stable powder feeding over long distances, up to 20 metres;
- Both pneumatic and gravity feeds are available.

Product name	Single Hopper Powder Feeder	Double Hopper Powder Feeder	Multi Hopper Powder Feeder	Gravity Powder Feeder
Powder hoppers	Single hopper	Double hopper	4/5/6 hopper	Number of hoppers optional (gas can be loaded)
Powder feeding rate capacity	0.4-300g/min	0.4-300g/min	0.4-300g/min	20-50g/min 20-400g/min 20-300g/min 0.1-100g/min
Powder feeding accuracy	≤±1%	≤±1%	≤±1%	≤±2%
Gas pressure	0.2-0.6mpa	0-0.6mpa	0-0.6mpa	0-0.6mpa
Gas flow	1-15L/min	1-15L/min	1-15L/min	\
Heating temperature	N/A、0-65℃	0-65℃	0-65℃	\
Single hopper volume	1.5/5L	1.5/5L	1.5/5L	1.5/5L
Applicable particle size	20-300μm	20-300μm	20-300μm	20-300μm
Drive motor	Stepping motor	Servo Motors	Servo Motors	DC Motor
Optional Functions	Stirring and heating	Stirring and heating dynamic weighing	Stirring and heating dynamic weighing	Roller type Electromagnetic type Screw type Linear type
Remote protocols	I/O	I/O/AI/Profinet/ Modbus	AI/Profinet/Modbus	\

Laser Welding System

Huirui Laser-arc hybrid welding equipment combine laser and MIG technology his hybrid technique is faster than MIG welding alone, and the parts are subject to less distortion.

- Energy utilization is much higher than the simple addition of two heat sources, with high welding speeds;
- Compared to conventional welding, hybrid welding has a greater depth of fusion and higher weld quality;
- The combination with laser helps to improve the stability of the arc and improves for the welding gap, thus increase efficiency.

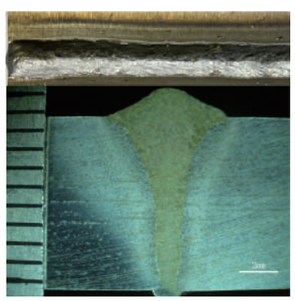
Main Configurations

Laser source max power	20kW
Fibre diameter	200um
Motion accuracy	KUKA KR210
Depth of fusion	9mm

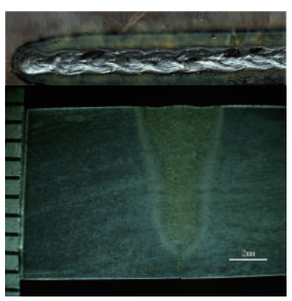
Equipment parameters

Welding method	Laser MIG
Laser power	5kW
Current	144A
Welding Voltage	16.7V
Scan velocity	10mm/s
Melt width	6.7mm

Process Testing



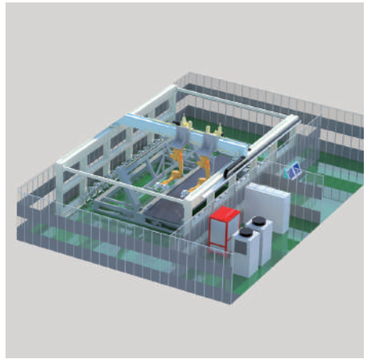
Section view of laser-arc hybrid



Section view of laser welding

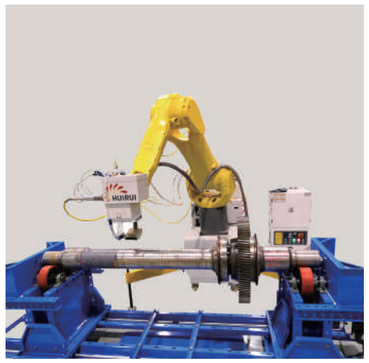
Top view of workpiece

Laser Cleaning System



Laser Cleaning Production Line

Green, efficient, flexible, easy-to-maintain and low-cost laser cleaning operations. For the removal of paint for masive-volume shaft parts, and at the same time, take into account the surface treatment of multiple types and workpieces.



Mobile Laser Cleaning System

The mobile kilowatt laser cleaning system is a high-power cleaning system, which can be used to remove metal surface oil, metal corrosion layer, all kinds of paint coatings, metal surface oxidation film and other metal coatings.

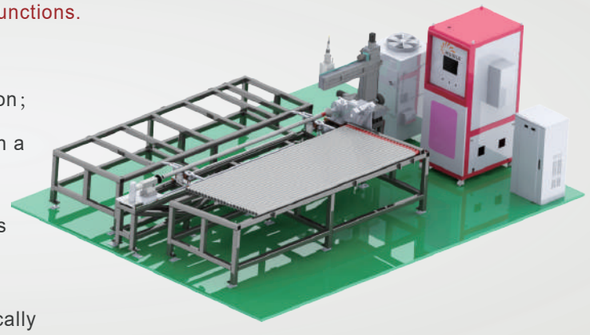
Portable Laser Cleaning Equipment

Hand held laser cleaning equipment based on low to medium power pulsed fibre lasers and high-speed scanning mirrors can be flexibly applied to a variety of cleaning-type surface treatment operations for industrial products.

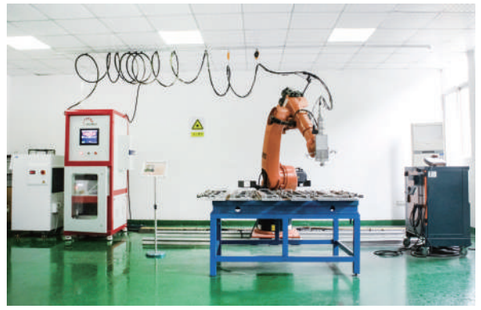
Laser HeatTreatment System

The production line can perform laser quenching process on the surface of steel tubes. Automatically load steel tubes to the workstation. With visual positioning and automatic clamping functions.

- Automatic loading and unloading rotary station;
- Locate the position to be laser quenched with a high-speed camera;
- Automatically locate the start point of threads and performsthe laser processing;
- When finished, the ejector cylinder automatically velocates the workpiece.



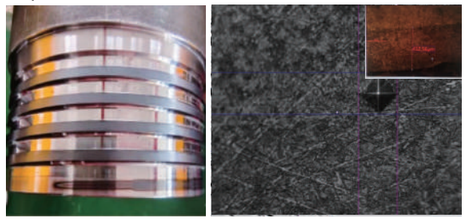
Robots	6-axis robot
Laser device	Diode laser source Laser
Laser power	3kW
Adjustable Spot Range	5X5-32X32mm（customizable）
System configuration	Dual colour infrared thermometer
	Closed-loop temperature control system



Laser Quenching System

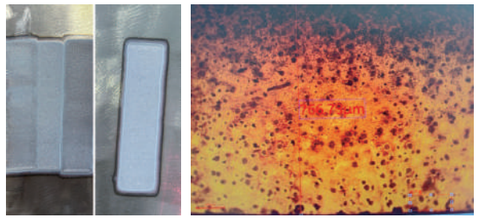
Process Testing

Experimental material: Threaded 40Cr



The depth of hardened layer is 0.3-0.5㎜, and the hardness improvement.Hardness improves from 30 to 58 HRC.
The local quenching thread area without any deformation, to ensure the accuracy of hardness.

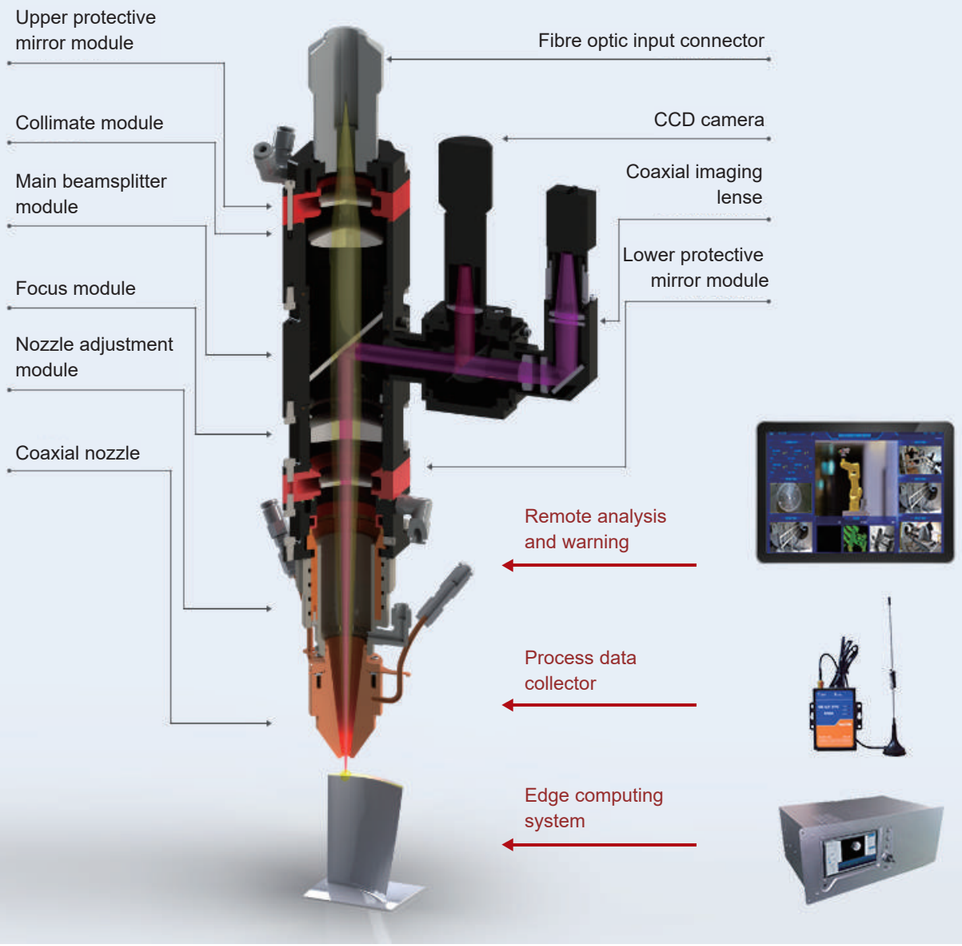
Experimental material: QT700



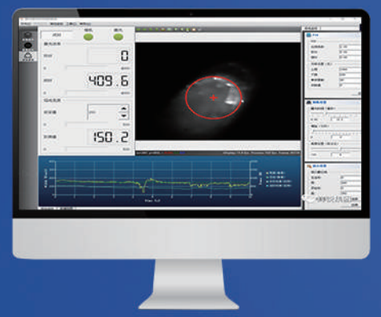
The surface of the workpiece after quenching is flat and smooth, the internal organisation is well-proportioned, and the effective depth of the hardened area is 0.65㎜.Hardness improves from 25 to 55 HRC.

A large database of laser powder deposition process with various high-performance alloys has been established based on a vast of application needs from many different industrial fields.

Intelligent Monitoring System



Huirui computer-aided additive manufacturing (CAMM) software package includes: system status monitoring, ImageSense, SmartVsion, DynamicHeat, ScanPath and other functional modules,enables the operability and reliability of metal 3D printing and repair a more intelligent process.



Melt Pool Monitoring And Temperature Closed Loop Control System

Closed-loop feedback control of the main parameters of the laser cladding process through optical and other monitoring means, real-time monitoring of size, shape and temperature of the molten pool and related data recording and analysis, real-time feedback adjustment or PID control of process parameters.

Adaptive Conformal Laser Cladding System

Huirui has developed an adaptive shape-tracking laser cladding system, which uses 2D or 3D sensors to automatically identify defects, locate targets, and generate machining paths, replacing traditional programming with manual instructions and greatly reducing processing time.

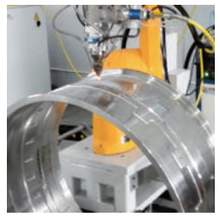
Multi-source Data Acquisition And Analysis System

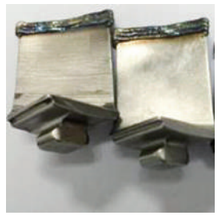
The system consists of an edge calculator, a 4G remote data collector, and a cloud computing platform. It can acquire many kinds of data such as temperature, flow rate and image at the same time, and process and analyse data.

INDUSTRIAL APPLICATION CASES

◎ Aerospace


Z-notch repair of
low pressure turbine blade


Casing repair

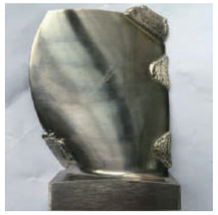

Compressor blade repair


Repair of external spline
shaft parts

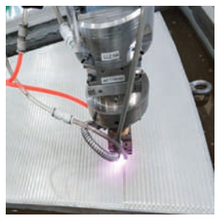

Blisk repair


High pressure turbine
blade repair


Seal tile repair


Blade notch repair

◎ Energy Power


Bearing tile babbatt alloy repair

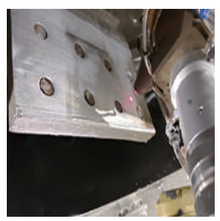

Gas turbine blade
tip filling


Hydro power guidevane repair


Anti-cavitation coating on
hydro power station

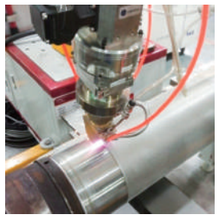

Hydro-power turbine coating

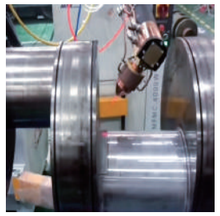

Bottom ring on-site repair

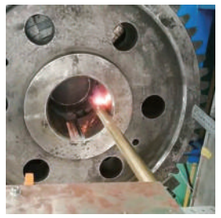

On-site repair of
aluminum enlosed busbar


Steam turbine blade repair

◎ Machinery


Ultra-high-speed cladding
of hydraulic cylinder surface


Drive shaft
(crankshaft) cladding

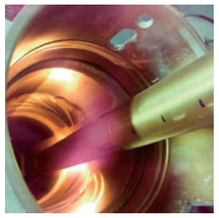

Reducer gear
(tooth surface) repair


CNC milling machine
spindle repair

◎ Petrochemical


Axle wear repair


Centralizer wear repair


Repair of internal holes in
petroleum drilling tools


Hastelloy impeller repair


Pressure compensator
wear repair


Spindle wear repair


IPTA drilling tool transfer
end face repair


Connection accessories repair

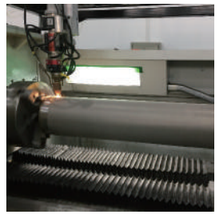

Chemical fiber tube
laser cladding

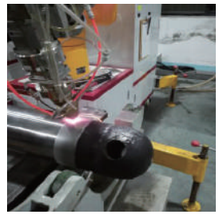

Chemical plant vacuum
pump blade fan repair


Ball valve cladding


Valve stem cladding

◎ Coal Mining Machinery


Hydraulic support
column repair


Living column cladding

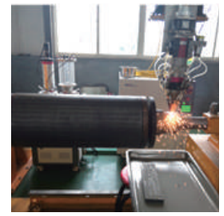

Sprocket repair


Laser cladding of picks


Internal hole
cladding cylinder

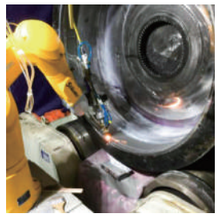

Bearing position and
key position cladding

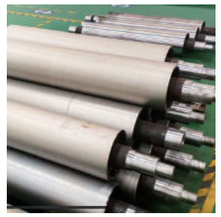

Scraper groove plate repair

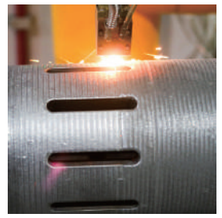

Shaft parts repair

◎ Steel miller equipment


Copper plate mold cladding

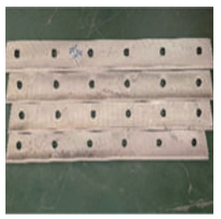

Repair of the inner ring bearing
surface of the crane drum


Laminar roller repair


Valve stem repair

◎ Agricultural Machinery Tools

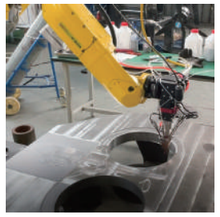

Wheat harvesting
knife cladding

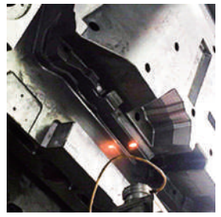

Corn harvester knife cladding


Crushing machine
knife cladding

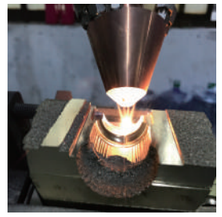

Lawn mower cladding

◎ Mould

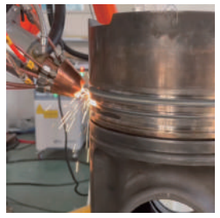

Cast iron arm repair


Various mold strengthening

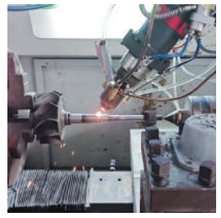

Bumper stamping die repair


Glass mold repair

◎ Shipyard

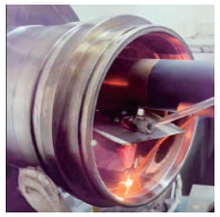

Piston head repair

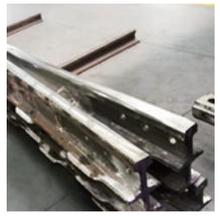

Pump shaft repair


Booster rotor shaft repair


Rudder repair

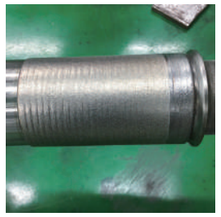
◎ Other Equipment


Cylinder liner repair

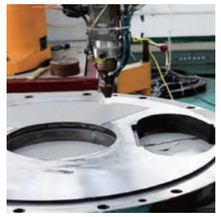

Repair of rail switch

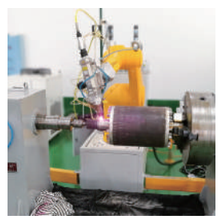

Laser repair of subway motor end cover


Laser surface treatment of high-speed sliding bed platen


Laser repair of vehicle axle parts


Wheel tread and rim laser repair


Site remediation


Intelligent rail motor rotor shaft repair

MATERIALS

	Metal Material	Application
Steel	316L,17-4PH,SS410,420,400	Stainless steel repair and forming
	H13(SKD61),P20,P21,CPM	Die casting ,oulds, Injection moulds
	40Cr,45#,CI60,42CrMo,40CrMnMo, 30CrMnSiA,39CrMoAI	Repair of shaft/tooth/disc parts
	INVAR	Low expansion coefficient materials
Cobalt Based	Stellite6,21,31,Co50, 42,Deloro50,60	Abrasion and corrosion resistant materials
Nickel Based	INCONEL718(GH4169),625	Turbine engine parts, oil drilling
	Waspalloy(GH738),GH4648, GH3030	Turbine engine parts
	CMSX-4,REene N5,DD6	Monocrystalline turbine blades
	Rene80,Rene142	Aero-engine magazines, blades
	Ni60,Deloro50,60	Aero-engine
Titanium Based	Ti-6AI-4V	Biomedical scaffolds, aircraft engines, petroleum
	TiAI	Turbine blade
	TiNi	Medical equipment
	TA15,TC17,TC2,TC4	Aerospace
Aluminium	AISi,AICu,AIMg,AIZn	Rail vehicles, aerospace
Metal-based Wear-resistant Ceramics	WC,SiC	Abrasion resistant material