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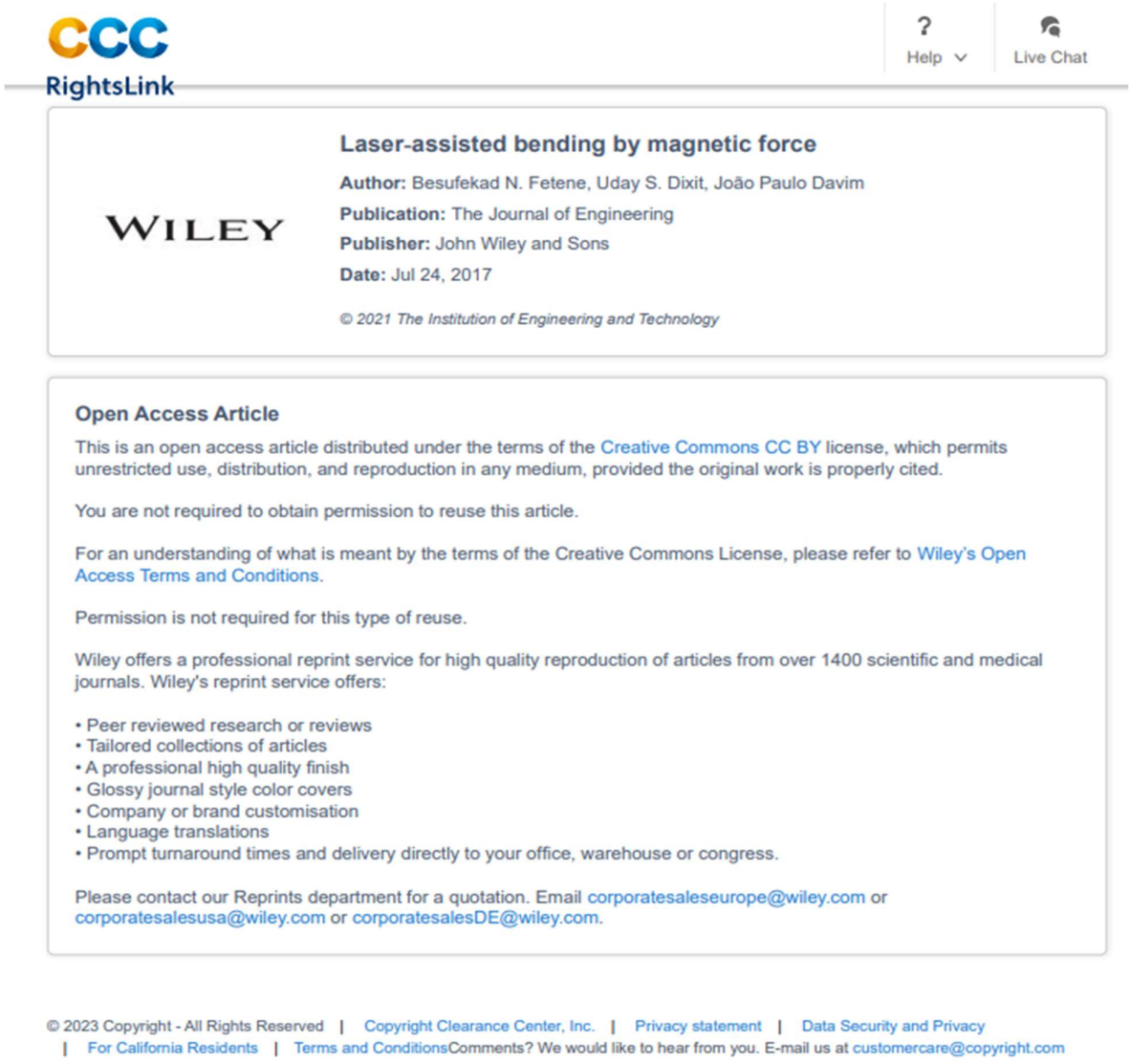

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Laser-assisted bending by magnetic force

Author: Besufekad N. Fetene, Uday S. Dixit, João Paulo Davim

Publication: The Journal of Engineering

Publisher: John Wiley and Sons

Date: Jul 24, 2017

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सूक्ष्म, लघु एवं मध्यम उद्यम मंत्रालय,
Government of India Society
Ministry of Micro, Small & Medium Enterprises

CTR TESTING LAB.

FM-02

Test Report

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Description : Sheet Sample	**Date of Issue** : 04/11/2022
Marking Ref: : N-26440	**Date of Receipt of Sample** : 04/11/2022
Qty : 1	**Date of Commencement of Test** : 04/11/2022
Work Order No. : S23340	**Details of Sample** :

Sealed /Unsealed :
Instrument Use: Spectrometer (GDS LECO 500 A)
Test Method : ISO:14707:15

Sl.No.	Test	Results
	ELEMENTS	Mark : 01 (Research work)
1	% Carbon (C)	0.098
2	% Manganese(Mn)	0.77
3	% Silicon (Si)	0.15
4	% Phosphorus (P)	0.017
5	% Sulphur (S)	0.006

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Appendix 3.2

SPECIFICATIONS OF LASER CUTTING MACHINE

Make	: Abro Technologies Pvt. Ltd
Model	: L3015
Working Area	: 1500 × 3000 mm
Axis travel X-axis	: 3000 mm
Axis travel Y-axis	: 1500 mm
Axis travel Z-axis	: 150 mm
Maximum positioning speed of X and Y-axis	: 70 m/min
Maximum positioning speed of Z-axis	: 20 m/min
Positioning Accuracy	: ±0.1 mm/m
Power supply	: 380 V, 50/60 Hz
Laser cutting control Software	: CypOne- 6.1.723
Assisted gas	: Oxygen/Nitrogen/Air

Appendix 3.3

SPECIFICATIONS OF FIBER LASER SOURCE

Make	: Max Photonics
Model	: MFSC-1000W
Type	: Fiber Laser
Capacity	: 1kW
Tuning range of output power	: 10-100%
Wavelength	: 1080±10 nm
Laser switching ON time	: 50-100 μs
Laser switching OFF time	: 50-100 μs
Spectrum width	: 3-5 nm
Beam quality (M2)	: 1.3
Red guide laser power	: 150 μW
Maximum modulation rate	: 20 kHz
Feeding fiber cable length	: 15 m
Feeding fiver core size	: 50 μm
Feeding fiber cable bending radius	: 200 mm
Cooling method	: Water cooling

Appendix 3.4

LASER DISPLACEMENT SENSOR SPECIFICATIONS

Make	**:** ILD1320-50 from Micro-Epsilon
Measuring range	: 50 mm
Start of measuring range	: 35 mm
End of measuring range	: 85 mm
Measuring rate	: 2 kHz
Repeatability	: 5 µm
Temperature stability	: ± 0.015 % FSO/ K
Light source	: Semiconductor laser < 1 mW, 670 nm (red)
Laser safety class	: Class 2 in accordance with IEC 60825-1: 2014
Supply voltage	: 11-30 VDC
Power consumption	: < 2 W (24 V)
Signal input	: 1 × HTL laser on/off; 1 × HTL multifunction
Input	: trigger in, zero setting, mastering, teach
Digital interface	: RS 422 (16 bit)/ PROFINET/ EtherNet/IP
Analog output	: 4 to 20 mA (12 bit; freely scalable within the measuring range)
Switching output	: 1 × error output: npn, pnp, push pull
Connection	: Integrated cable 3 m, open ends, minimum
Bending	: radius 30 mm (fixed installation)
Mounting	: Screw connection via two mounting holes
Operation temperature range	: 0 to + 50 °C (non-condensing)
Material	: Aluminium housing
Weight	: Approx. 30 g (without cable), approx. 145 g (including cable)

Appendix 3.5

THERMAL IMAGING CAMERA SPECIFICATIONS

Make : FLIR

Model : A315

Imaging and optical data

Field of view (FOV)/ Minimum focus distance : 25° × 18.8° / 0.4 m (1.31 ft.)

Spatial resolution (IFOV) : 1.36 mrad

Focal length : 18 mm (0.7 in.)

F-number : 1.3

Image frequency : 60 Hz

Lens identification : Automatic

Thermal sensitivity/NETD : < 0.05°C @ +30°C (86°F)/ 50 mK

Focus : Automatic or manual (built in motor)

Detector data

Focal plane array (FPA)/ Spectral range : Uncooled microbolometer / 7.5-13 µm

IR resolution : 320 × 240 pixels

Detector pitch : 25 µm

Detector time constant : Typical 12 ms

Measurement

Object temperature range : -20 to +120°C, 0 to 500°C, 0 to 2000°C

Accuracy : ±2°C or ±2% of reading

Measurement analysis

Atmospheric transmission correction : Automatic, based on inputs for distance, atmospheric temperature and relative humidity

Optics transmission correction : Automatic, based on signals from internal sensors

Emissivity correction : Variable from 0.01 to 1.0

Reflected apparent temperature correction : Automatic, based on input of reflected temperature

External optics/windows correction : Automatic, based on input of optics/window transmission and temperature

Measurement corrections : Global object parameters

Ethernet : Control and image

Ethernet, image streaming : 16-bit 320 × 240 pixels at 60 Hz,

Signal : linear, Temperature linear, Radiometric, GigE Vision and GenICam compatible

Ethernet, standard : IEEE 802.3

Ethernet, connector type : RJ-45

Ethernet, type : Gigabit ethernet

Ethernet, communication : TCP/IP socket-based FLIR proprietary and GenICam protocol

Ethernet, protocols : TCP, UDP, SNTP, RTSP, RTP, HTTP, ICMP, IGMP, ftp, SMTP, SMB (CIFS), DHCP, MDNS (Bonjour), uPnP

Digital input/output

Digital input : 2 opto-isolated, 10-30 VDC

Digital output, purpose : Output to ext. device (programmatically set)

Digital output : 2 opto-isolated, 10-30 VDC, max 100 mA

Digital I/O, isolation voltage : 500 VRMS

Digital I/O, supply voltage : 12/24 VDC, max 200 mA

Digital I/O, connector type : 6-pole jackable screw terminal

Digital input, purpose : Image tag (start, stop, general), Image

Flow ctrl. : (Stream on/off), Input ext. device (programmatically read)

Power system

External power operation : 12/24 VDC, 24 W absolute max

External power, connector type : 2-pole jackable screw terminal

Voltage : Allowed range 10-30 VDC

Environmental data

Storage temperature range : -40°C to +70°C

Humidity (operating and storage) : IEC 60068-2-30/24 h 95%, relative

Humidity : +25°C to +40°C

EMC : EN 61000-6-2:2001 (Immunity) EN 61000-6-3:2001 (Emission) FCC 47 CFR Part 15 Class B (Emission)

Vibration : 2 g (IEC 60068-2-6)

Appendix 3.6

SCANNING ELECTRON MICROSCOPE SPECIFICATIONS

Make : JSM-6610LV from JEOL

Resolution HV mode : 3 nm (30 kV), 8 nm (3 kV), 15 nm (1 kV)

LV mode : 4 nm (30 kV)

Magnification : × 5 to × 300000 (on 128 mm × 96 mm image size)

Pre-set magnifications : 5 step, user selectable

Standard recipe : Built in

Custom recipe : Operation conditions (optics, image mode, LV pressure) specimen stage

Image mode : Secondary electron image, REF image, Composition, Topography, Shadowed

Accelerating voltage : 0.3 kV to 30 kV

Filament : Factory pre-centered filament

Electron gun : Fully automated, manual override

Condenser lens : Zoom condenser lens

Objective lens : Super conical objective lens

Objective lens apertures : 3 stages, XY fine adjustable

Stigmator memory : Built in

Electrical image shift : ± 50 μm (WD = 10 mm)

Auto functions : Focus, brightness, contrast, stigmator

Specimen stage : Eucentric large-specimen stage axes motorized

X: 125 mm, Y: 100 mm, Z: 5 mm to 80 mm, Tilt: -10° to 90°, Rotation: 360°

Reference image (Navigator) : 4 images

Specimen exchange : Draw out the stage

Maximum specimen : 200 mm diameter

Measurement : Built in

Image format : bmp, tiff, jpeg

Auto image archiving : Built in

Pumping system : Fully automated, DP: 1, RP: 1 or 2

Switching vacuum mode : Through the menu, less than 1 minute

LV Pressure : 10 to 270 Pa

JED-2300 EDS : Built in

Appendix 3.7

MICROHARDNESS TESTER SPECIFICATIONS

Make : 402 MVD from Wilson

Hardness scales : Vickers and Knoop

Test load : 10, 25, 50, 100, 200, 300, 500, 1000, 2000 gf

Test load selection : Dial

Accuracy : Conforms to EN-ISO 6507, ASTM E384 and E92

Load control : Automatic (loading/dwell/unloading)

Load duration (dwell time) : 5-99 seconds

Turret : Automatic

Eyepiece magnification : 10X

Digital encoder resolution : 0.1 μm

Objectives : 10X, 40X

Total magnification : 400X (for measurement)

Measuring range : 100X (for observation), 200 μm

Optical path : 2-way switchable- eyepiece/camera

Light filter : Green and blue

Light source : Halogen lamp

Display : Length of diagonal, hardness converted value, test force

Hardness value : 5-digit

Diagonal length : 4-digit (D1, D2)

Data output : Built-in printer, RS232

Statistics : Number, average, standard deviation, range

Conversion : Brinell, Rockwell, superficial Rockwell, tensile strength

Maximum specimen height : 85 mm (2.55 in)

Depth from the centreline : 120 mm (3.35 in)

XY-stage dimensions : 100 × 100 mm

XY-stage travel range : 25 × 25 mm

Minimum reading : 0.01 mm

Operating temperature range : 10° to 38° C

Humidity : 10%-90% non-condensing

Dimensions : 513 × 320 × 470 mm

Weight : 36 kg

Power supply : 110-220 V AC, 60/50 Hz