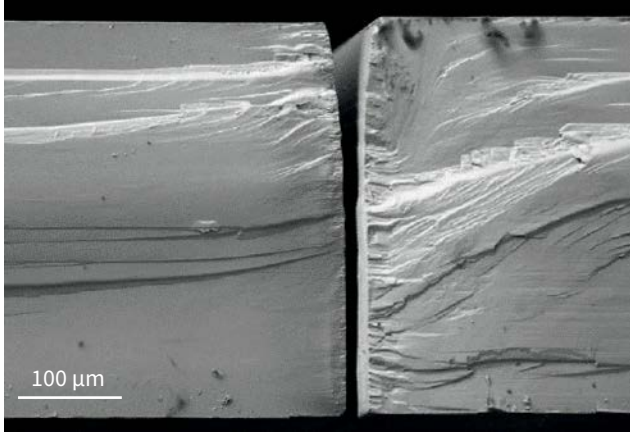


EXAMPLES OF INDUSTRIAL APPLICATIONS

Brittle & highly thermal sensitive material cutting



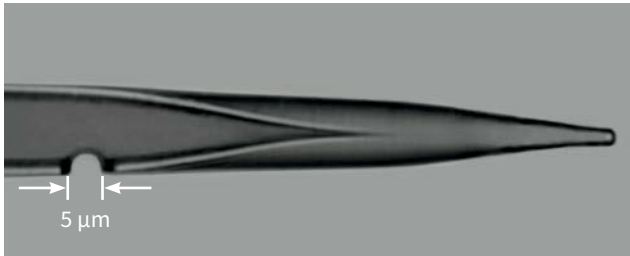
Multi-pass, cadmium tungstate cutting. No cracks. All thermal trace effects eliminated. Source: Micronanics Laser Solutions Centre.

Stainless steel stent cutting



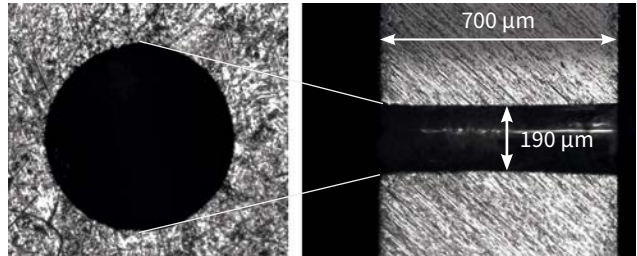
Stent cut using CARBIDE laser. Source: Amada Miyachi America.

Glass needle microdrilling



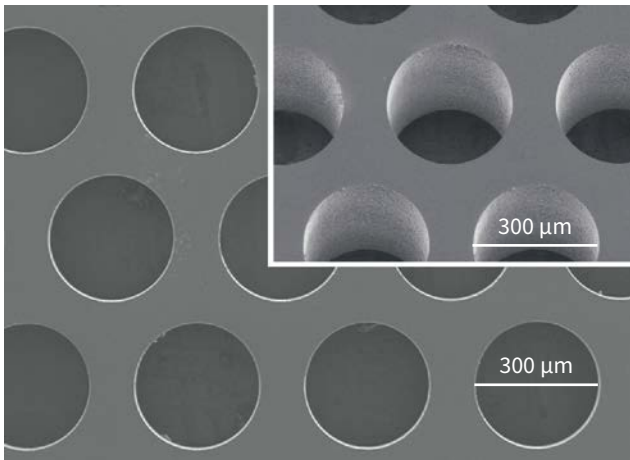
Glass needle microdrilling. Source: Workshop of Photonics.

Steel drilling



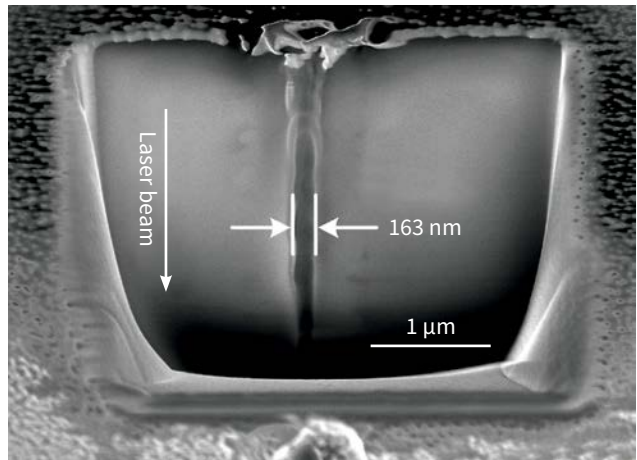
Taperless hole microdrilling in stainless steel alloys. Source: Workshop of Photonics.

Various type glass drilling



Various glass drilling. Source: Workshop of Photonics.

Nanodrilling in fused silica



Longitudinal section of the single void. Source: "Ultrashort Bessel beam photoinscription of Bragg grating waveguides and their application as temperature sensors", G. Zhang, G. Cheng, M. Bhuyan, C. D'Amico, Y. Wang, R. Stoian. Photon. Res. (2019).

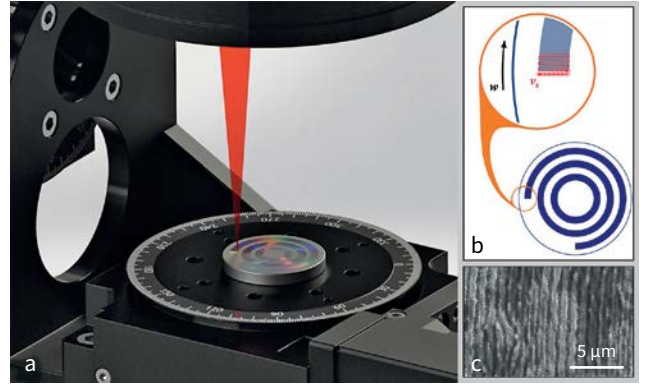
Milling of complex 3D surfaces



3D milled sample in copper. Zoom in SEM image.

Source: "Highly-efficient laser ablation of copper by bursts of ultrashort tuneable (fs-ps) pulses", A.Žemaitis, P.Gečys, M.Barkauskas, G.Račiukaitis, M.Gedvilas. Scientific Reports (2019).

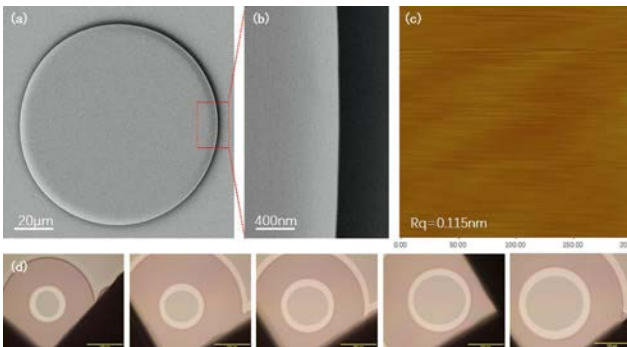
Friction and wear reduction



(a) Schematic of the laser treatment, (b) laser patterning strategy, (c) SEM image of induced LIPSS.

Source: "Tribological Properties of High-Speed Uniform Femtosecond Laser Patterning on Stainless Steel", I.Gnilitskiy, A.Rota, E.Gualtieri, S.Valeri, L.Orazi. Lubricants (2019).

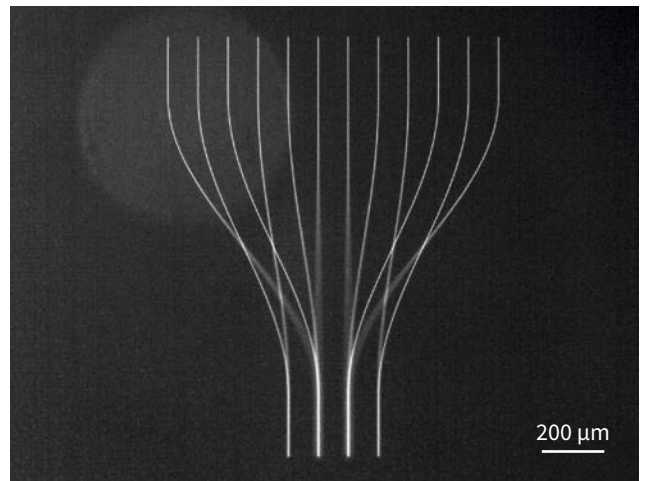
Selective Cr thin film ablation



(a) SEM image of a fabricated LiNbO_3 micro-disk resonator, (b) close up view, (c) atomic force microscope (AFM) image of micro-disk wedge, (d) optical microscope image of micro-disk resonator with different diameters.

Source: "Fabrication of Crystalline Microresonators of High Quality Factors with a Controllable Wedge Angle on Lithium Niobate on Insulator", J.Zhang, Z.Fang, J.Lin, J.Zhou, M.Wang, R.Wu, R.Gao, Y.Cheng. Nanomaterials (2019).

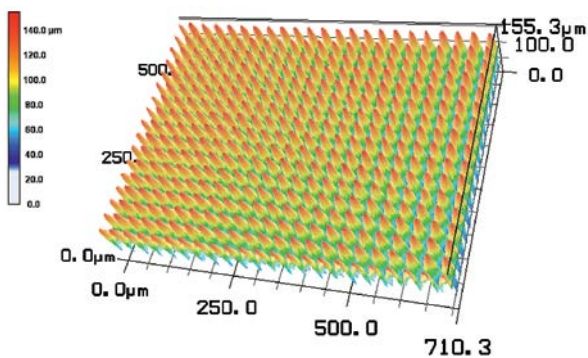
3D waveguides



3D waveguide fabricated in fused silica glass.

Source: Workshop of Photonics.

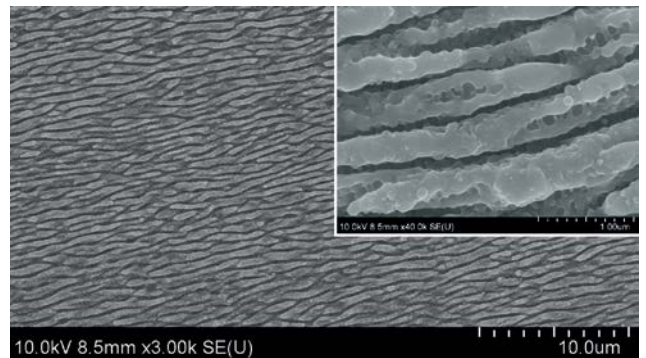
Terahertz broadband anti-reflection structures



Fabricated moth-eye 3-D profile image, taken by laser scanning microscope.

Source: "Terahertz broadband anti-reflection moth-eye structures fabricated by femtosecond laser processing", H.Sakurai, N.Nemoto, K.Konishi, R.Takaku, Y.Sakurai, N.Katayama, T.Matsumura, J.Yumoto, M.Kuwata-Gonokami. OSA Continuum (2019).

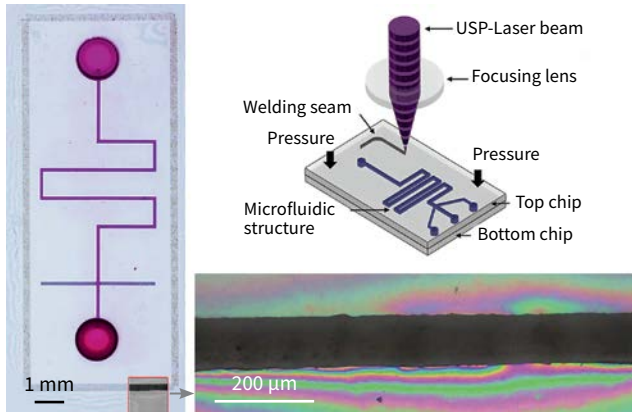
Surface-enhanced Raman scattering (SERS) sensors fabrication



SEM image of the Ti-6Al-4V (TC4) surface after irradiation with progressively laser scan.

Source: "Large-Scale Fabrication of Nanostructure on Bio-Metallic Substrate for Surface Enhanced Raman and Fluorescence Scattering", L.Lu, J.Zhang, L.Jiao, Y.Guan. Nanomaterials (2019).

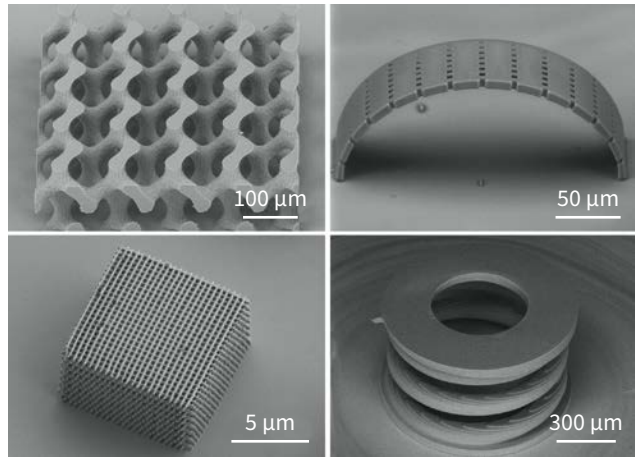
Lab-on-chip channel ablation and welding



(a) Welding of transparent polymers for sealing of microfluidic devices, (b) COC welding seam (c) top view on a sealed microfluidic device.

Source: "A New Approach to Seal Polymer Microfluidic Devices Using Ultrashort Laser Pulses", G. Roth, C. Esen and R. Hellmann. JLMN-Journal of Laser Micro/Nanoengineering (2019).

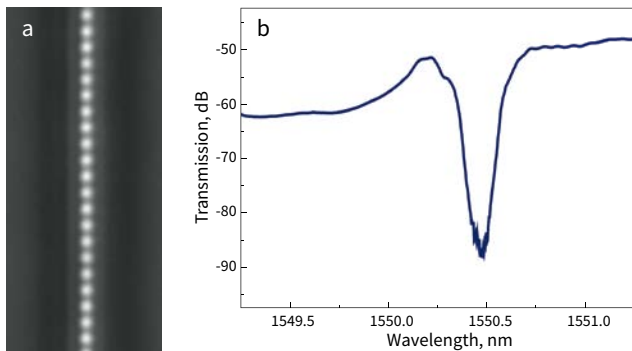
3D micro printing using multi-photon polymerization



Various 3D structures fabricated in SZ2080 polymer using multi-photon polymerization – nanophotonic devices, microoptics, micromechanics.

Source: Femtika.

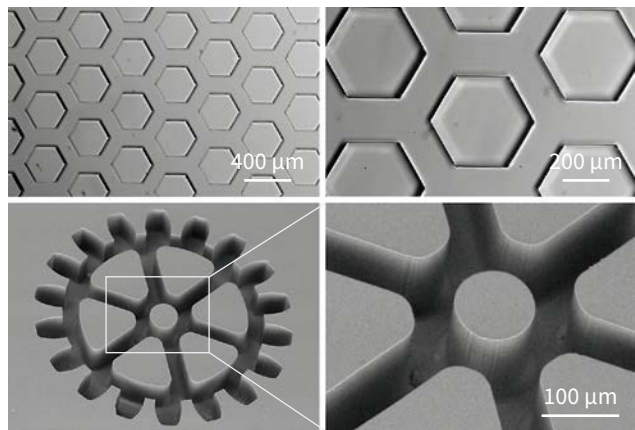
Bragg grating waveguide (BGW) writing



(a) first-order Bragg gratings inscribed in written waveguide, (b) Resonant spectral transmission of inscribed BGW.

Source: "Ultrashort Bessel beam photoinscription of Bragg grating waveguides and their application as temperature sensors", G.Zhang, G. heng, M.Bhuyan, C.D'Amico, Y.Wang, R.Stoian. Photon. Res. (2019).

3D glass etching



Various structures fabricated in fused silica glass.

Source: Femtika.

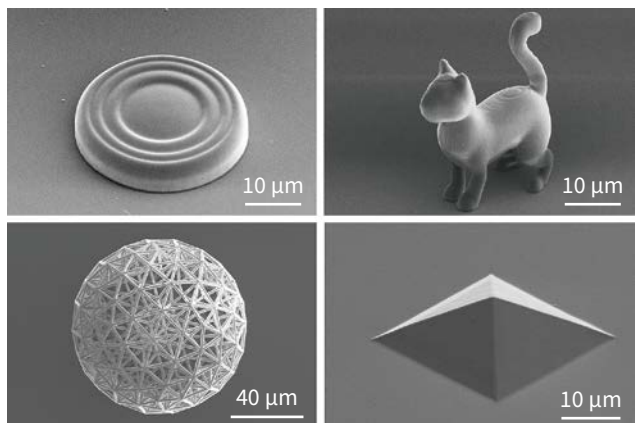
Birefringent glass volume modifications



Form induced birefringence-retardance variation results in different colors in parallel polarized light.

Source: Workshop of Photonics.

3D free shape multi-photon polymerization



Various 3D structures fabricated in SZ2080 polymer using multi-photon polymerization.

Source: Workshop of Photonics.