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RESEARCH PAPERS

Micromachining of Metals, Alloys, and Ceramics by Picosecond Laser Ablation

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Microhole drilling and microstructure machining with a picosecond (ps) Nd:YVO_4 laser (pulse duration of 10 ps) in metals, alloys, and ceramics are reported. Blind and through microholes are drilled by percussion drilling as well as trepanning drilling, where the diameters of the holes are in the range of 20–1000 μm. Microfeatures are also machined and the flexibility of ps laser machining is demonstrated. The quality of drilled holes, e.g., recast layer, microcrack, and conicity, and that of the microstructures, are investigated by an optical microscope, a surface profilometer, or a scanning electron microscope. Ps laser ablation rate is studied by experiments and a simplified laser ablation model.

Issue Section: Research Papers
Keywords: alloys, ceramics, drilling, laser beam machining, microcracks, micromachining, scanning electron microscopy
Topics: Drilling, Laser ablation, Lasers, Machining, Metals, Micromachining, Alloys, Ceramics, Ablation (Vaporization technology)

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Picosecond lasers offer an interesting compromise for material ablation that has been studied by several authors [17, 20, 24–28]. Whereas nanosecond ablation has high energy per pulse and high ablation rate, and femtosecond lasers have small thermal penetration depth and high. 0960-1317/13/055021+14$33.00. [27] Hu W, Shin Y C and King G B 2010 Micromachining of metals, alloys, and ceramics by picosecond laser ablation J. Manuf. Sci. Eng. 132 011009. [28] Popovic D M, Zekic A A, Trtica M and Stasic J 2012 Synthesis of silicon nanoparticles by picosecond laser ablation in liquid proc Proc. Nanotech 2012: Electronics, Devices, Fabrication, MEMS, Fluidics and Computational (Santa Clara, CA, USA). High quality laser milling of ceramics, dielectrics and metals using. nanosecond and picosecond lasers. Dimitris Karnakis. picosecond laser, a pulse picker and a regenerative amplifier delivering output power of up to 10 W at the. fundamental wavelength of 1064nm. They feature high beam quality (M^2<1.2) and a very high repetition rate (up to 500. main difficulty arises from the high ablation threshold of metals and their high reflectivity at most common laser. wavelengths. This makes the process non-economical, as the energy coupling efficiency is low. In addition owing to the. extensive thermal penetration depth, laser melting and recast dominates the process resulting in poor feature quality. What is “Laser Ablation”? Mass removal by coupling laser. energy to a target material. University of California at Berkeley Q Lawrence Berkeley National Laboratory. laser ablation. Is it important?) Film deposition. * oxide/superconductor films * nanocrystals/nanotubes. J. C. Miller & R. F. Haglund, Laser Ablation and Desorption. (Academic, New York, 1998). University of California at Berkeley Q Lawrence Berkeley National Laboratory. Laser Ablation.) What is happening? laser pulse. target. Laser - based material processing is well investigated for structuring , modification , and bonding of metals , ceramics , glasses, and polymers . Especially for material processing on micrometer, and... W. Pfleging et al., Rapid fabrication and replication of metal, ceramic and plastic mould inserts for application in microsystem technologies . Proc. Inst. J.Y. Cheng et al., Direct-write laser micromachining and universal surface modification of PMMA for device development. Sens. Actuators B 99, 186–196 (2004)CrossRefGoogle Scholar. A picosecond laser was used to machine this micro-mold that measures 2 mm long by 500 microns wide by 600 microns deep. A picosecond laser was used to machine this micro-mold that measures 2 mm long by 500 microns wide by 600 microns deep. This also enables the laser to machine non-metals such as Teflon, diamond, ceramics and glass without microcracking or chipping their surface. The minimal thermal and mechanical effects associated with cold ablation allows for a high repetition rate, which translates to high ablation (material removal) rates. The repetition rate of the RAPID laser is 500 kHz, which means ablation rates for steel can be as much as 1 mm^3/min for an 8 kW laser. There are four common techniques for laser micromachining of metals.