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Platinum micromachining using femtosecond laser pulses

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Material deposition in microscale has several applications, from microelectronics and integrated optics to the production of biological devices. Direct Laser Writing (DLW) techniques interest in micromachining have grown considerably in the past few years due to its ability to print functional materials, such as metals. (1) Usually, DLW techniques include advantages such as high resolution, processing time, control of deposition size and thickness, while maintaining the material properties. The Laser Induced Forward Transfer (LIFT) is a DLW technique, whose principle is to transfer energy from the laser pulse to the sample, ejecting material droplets from the region where the laser beam is focalized. The nonlinear light-matter interaction generates nonlinear ionization in the focal volume, creating a plasma, which will cause the thermal stress and dissipation and, therefore, the optical breakdown and the nanoparticles deposition. The thermal dissipation takes place in nanoseconds, which is slower than the pulse duration (fs), so the thermal dissipation is confined in the focal volume, causing less damage in the areas nearby. The metals micromachining has been drawing attention due to its applications. Platinum micromachined structures are used to produce sensors, because of the material stability in different conditions and other applications. In this work, it has been studied the Pt micromachining using femtosecond laser LIFT, in order to find the best conditions to deposit Platinum nanoparticles (PtNP's). For this, the zero damage method and the incubation effect were used. After that, we've evaluated the micromachining of structures for different applications. The depositions were made in 1st and 2nd harmonic, centered at 1030 nm (μJ range pulse energies) and 515 nm (nJ range pulse energies), respectively, and 1 to 100 kHz of repetition rates. It was possible to verify that the optimum conditions to micromachine PtNP's, for 1st harmonic, is using pulse energies around 4 μJ and repetition rate around 1 kHz, and 2nd harmonic, is using pulse energies around 12 nJ and repetition rate around 5 kHz. Additionally, the SEM images revealed the controlled and localized deposition of PtNP's.

Palavras-chave: Micromachining. Platinum. LIFT.

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Referências:

1 ESROM, H. *et al.* New approach of a laser-induced forward transfer for deposition of patterned thin metal films, **Applied Surface Science**,v. 86, n.1-4,p. 202–207, 1995.