Laser : a tool for material processing at nanometer scale.

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Rapid development of fast and ultrafast lasers has opened a wide variety of new and exciting applications and possibilities for 2D and 3D high precision material processing. During the two last decades, lasers have demonstrated their ability of micro-machining and micro-structuring almost any material by direct ablative processing, self nanostructuring and also to produce nanoclusters with a control size distribution. This result together with the reductions in cost and complexity of laser systems have peaked interest in short and ultrashort laser ablation for synthesis of materials with highly ordered structures at the nanometer scale with unusual physical properties that allow their use as nanoscale devices in microelectronics, optics, bio-chemistry, etc. In the present report different laser processes to produce nanostructures such as laser ablation in liquids (fig. 1), self structuring (fig.2 and 3), nanocluster and particle-assisted laser near field enhancement (fig. 4) will be presented.

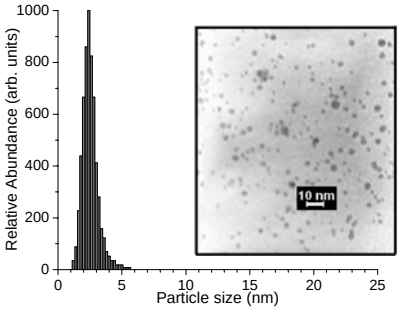

Fig 1: *Colloidal Au nanoparticles produced by fs laser ablation in aqueous solutions [1].*

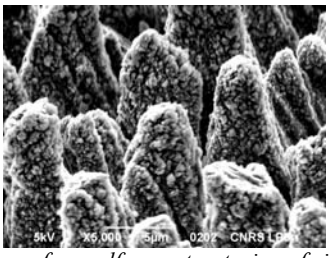

Fig 2 : *laser surface self nanostructuring of silicon (λ = 800 ns, pulse duration 100 fs) [2].*

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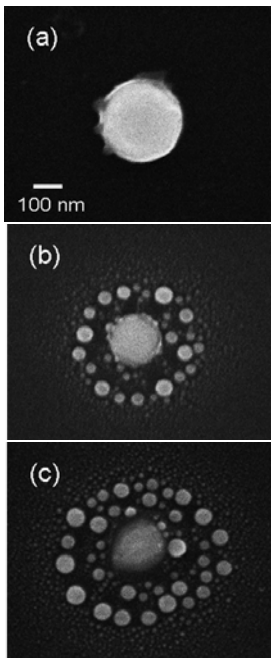

Fig. 3. *SEM images of a 125 nm radius Au particles deposited on Si substrates and irradiated by single laser pulses (λ = 193 nm) with different laser fluences: (a) 200 mJ cm^{-2}, (b) 280 mJ cm^{-2} and (c) 350 mJ cm^{-2} [3].*

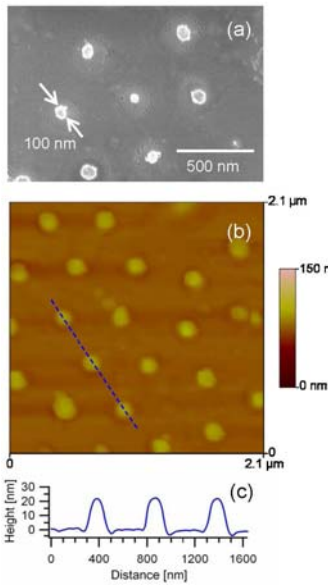

Fig. 4: *(color online) SEM image (a), AFM image (b) and depth profile (c) of gold nanodotscreated on silicon substrates by the LF-PAM based process [4]*

[1] A.V. Kabashin et. al., J. Phys. Chem B, 107, 4527 (2003)
[2] M Halbwax et al., *Thin Solid Films* **516**, 6791-6795, (2008).
[3] D. Grojo, *Applied Surface Science* **253,** p. 8309-8315 (2007)
[4] A. Pereira et al., Small **4** (5), 572-576, (2008).