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Advances in micro/nano scale materials processing by ultrafast lasers

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Materials processing by ultrafast lasers offers several attractive possibilities for micro/nano scale applications based on surface and in bulk laser induced modifications. The origin of these applications lies in the reduction of undesirable thermal effects, the non-equilibrium surface and volume structural modifications which may give rise to complex and unusual structures, the supression of photochemical effects in molecular substrates, the possibility of optimization of energy dissipation by temporal pulse shaping and the exploitation of filamentation effects. Diverse applications will be discussed, including the development and functionalization of laser engineered surfaces, the laser transfer of biomolecules and the functionalization of 3D structures constructed by multiphoton stereolithography. Two examples will be presented in this context: A new approach for the development of superhydrophobic, self-cleaning surfaces [1,2] and the fabrication of functional scaffolds for tissue engineering applications [3-5].

References:

[1] V. Zorba et al., "Biomimetic artificial surfaces quantitatively reproduce the water repellency of a Lotus leaf", Advanced Materials 20, 4049 (2008).

[2] V. Zorba et al., "Tailoring the wetting response of silicon surfaces via fs laser structuring", Applied Physics A 93, 819 (2008).

[3] V. Dinca et al., "Quantification of the activity of biomolecules in microarrays obtained by direct laser transfer", Biomedical Microdevices 10, 719 (2008).

[4] B. Hopp et al., "Laser-based techniques for living cell pattern formation", Applied Physics A 93, 45 (2008).

[5] V. Dinca et al., "Directed three-dimensional patterning of self-assembled peptide fibrils", Nano Letters 8, 538 (2008).