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Soft pulsed laser technologies for the transfer and processing of organic and biological/vivid materials

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Basic principles of laser pulses interaction with solid and liquid materials using advanced pulsed laser technologies are introduced and new recent results in synthesis of biomaterial layers are reviewed. Selection by combinatorial pulsed laser deposition of silver-doped carbon structures with reliable physical-chemical characteristics and high efficiency against microbial biofilms is presented. In-vitro biological assays were carried out using a large spectrum of bacterial and fungal strains, *i.e. Staphylococcus aureus, Staphylococcus epidermidis, Pseudomonas aeruginosa, Enterococcus faecalis and Candida albicans*. The biocompatibility of the films was evaluated on MG63 mammalian cells. The optimal combination with reasonable physical-chemical properties, efficient protection against microbial colonization and beneficial effects on human cells was found for silver-doped carbon films containing 2 to 7 at.% silver. These mixtures can be used to fabricate safe and efficient coatings of metallic implants, with the goal to decrease the risk of implant associated biofilm infections which are difficult to treat and often responsible for implant failure. In our opinion, these characteristics recommend the films with more than 2 and less than 7 at.% Ag concentration as the best compromise for the development of a new generation of smart coatings for orthopedic, cardiology or dental implants. Combinatorial - matrix-assisted pulsed laser evaporation was applied to synthesize crystalline gradient thin films with variable composition of Sr-substituted hydroxyapatite and zoledronate modified hydroxyapatite. The inhibitory action of zoledronate on osteoclast viability and activity is more efficient than that of Sr, which however plays a greater beneficial role on osteoblast proliferation and viability. The technique allows to modulate the composition of thin films and hence the promotion of bone growth and the inhibition of bone resorption. Thin films prepared by pulsed laser techniques are identical in chemical composition, structure, morphology, and most likely functionality resembling the base material, as proved by physical-chemical characterization and in-vitro testing. Combinatorial methods open the possibility to combine and immobilize two or more organic materials on a substrate in a well defined manner by laser evaporation under protection.

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