

PREPARATION AND CHARACTERIZATION OF METALORGANIC PRECURSORS FOR LASER FABRICATION OF 3D MICRO-/NANO-STRUCTURES

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Direct laser writing using multi-photon polymerization has become a powerful technique for the fabrication of fullythree-dimensional micro- and nano-structures for diverse applications in microfluidic, micro mechanic and electronic, biomedical, metamaterial as well as nano-phonic research fields [1, 2]. Such numerous applications require precursors with different chemical, physical and optical properties. Development of new chemical composition materials suitable for both laser 3D polymerization and optimized for applications remains an urgent and timely task.

The aim of this work was to synthesize a series of organic-inorganic polymer precursors [3] and investigate the prospects of 3D formation of these materials as well as to evaluate the diffusion of polymerization reactions in both absence and presence of an inhibitor in the starting mixture. The following steps have been accomplished to achieve this goal. First silicon and zirconium hybrid compounds were synthesized *via* sol-gel method varying the molar ratio of silicon (Si) and zirconium (Zr) complexes (Si:Zr, where Si=9; 8; 7; 6; 5 and Zr=1; 2; 3; 4; 5). Secondly, the influence of polymerization inhibitor concentration on structure resolution was experimentally evaluated. Differences in chemical composition of synthesized sols, gels and polymers were determined using Fourier transform infrared spectroscopy (FTIR). Measurements of absorption spectra and refractive indices were performed for determination of differences in optical properties. Scanning electron microscopy (SEM) images of fabricated 3D structures (periodic lattices and resolution bridges) revealed the suitability of precursors for laser lithography.

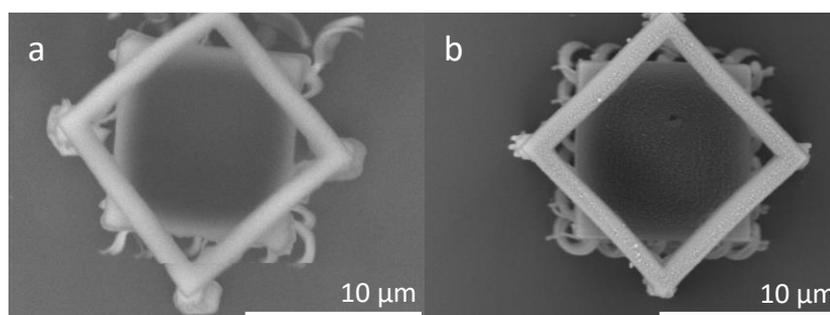


Fig. 1 SEM micrographs of cube structure in absence (a) and presence (b) of an inhibitor in the starting mixture.

The study shows that silicon and zirconium hybrid organic-inorganic compounds synthesized by the sol-gel method are suitable for 3D laser lithography and the inhibitor has an effect on structure resolution (Fig. 1). Qualitative and quantitative analysis of the inhibitor influence on the diffusion of polymerization reactions will be presented and discussed.

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