Summary

Stage IV Preliminary experimentations of photonic processing of ormosil under the form of 3D scaffold and characterization of the obtained structure

Three photo-polymerizable hybrid dimethacrylates were synthesized which contain in their chemical structure urethanic and/or ureic/flavoured ring groupings along with those derived from triethoxysilane. Also, a dimethacrylate was prepared in which the hybrid component is given by polydimethylsiloxane, of whose supplementary purification was required by the presence of unwanted impurities which appeared during the synthesis process.

Two-photon polymerization experiments were continued on hybrid monomers, also using the newly synthesized monomers. The monomers that were used are SIM 1 and SIM 1 combined with TA1. For the two photon polymerization (2PP), the experimental setup described in previous reports was used. The same femtosecond laser working at a wavelength of 775 nm, having a pulse duration of 200 fsec and a pulse repetition rate of 2 kHz was used.

The utilized solvent was tetrahydrofuran and the initiator was IRG 369. By varying the process parameters, namely: i) the laser power; ii) the scanning speed; iii) the solvent/monomer/initiator ratio; iv) the time after which the solution was processed; v) the scaffold geometry, complex structures were created, adherent to the substrate, which maintain their shape both during the developing, as well as after that. Three dimensional structures were created, with heights of tens on microns (going up to 60-70 microns).

The thermal degradation was studied, both for the new ormosil type monomers, with different compositions (SIM 1 and TA1, respectively), as well as for polymers formed after the photoprocessing of ormosils (SIM 1 polymer, TA1 polymer, and SIM1 (50%) - TA1 (50%) polymer, respectively).

The polymer having the structure SIM1-N,N'-(methacryloyloxyethyldiethoxy-methylsilylpropyl) urea was also characterized by analysis on aqueous extract: reducing substances, pH, absorbance.

Fibroblast cultivation experiments on polymeric scaffolds were realized with the aim of obtaining dermal grafts. Studies have showed that the structures obtained in this project are not toxic for the human dermal fibroblast cells which we worked with. The variation of the

deposition parameters and of the structure sizes influences the adhesion and the cellular morphology. The cells align in perfect parallelism with the polymer fibers and they maintain their intercellular communication capacity and their proliferating potential.

Ultimately, after optimization, the 3D structures obtained by two-photon polymerization have an orderly and controllable aspect (Fig. 1). This fact allowed the successful realization of cell cultures (fibroblasts) which proliferate and reorganize along the polymeric structure (Fig. 2).

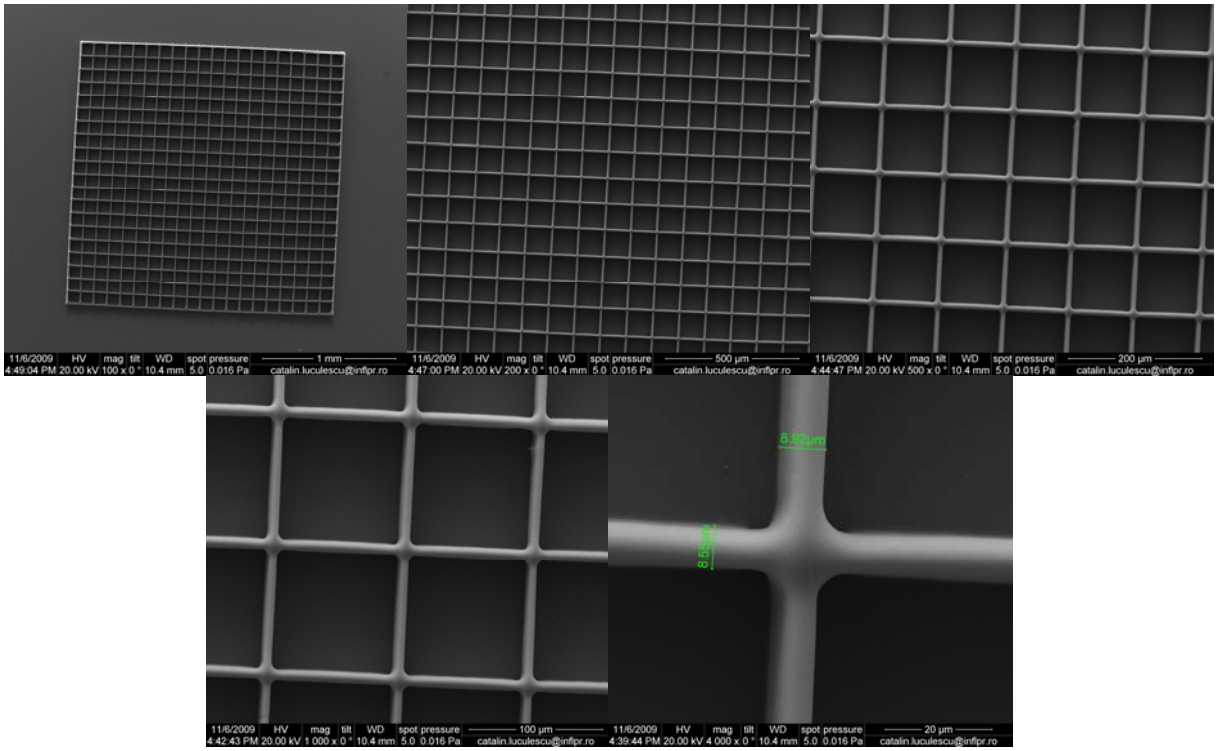

Fig. 1. SEM images on 20x20 lines matrix of polymerized SIM 1

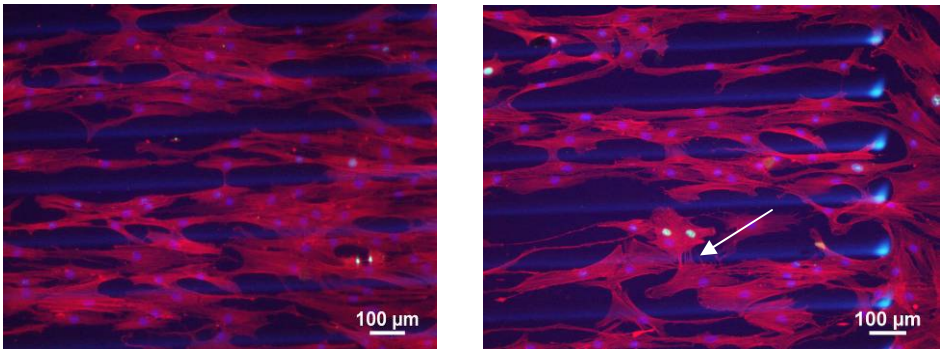

Fig 2. Fibroblasts grown on 2 structures of SIM 1 polymer lines

The obtained nano-bio-polymer structures can be considered for advanced studies with the aim of using them as supports for the realization of skin grafts.