An Aluminium-Based Hybrid Material for Laser Multiphoton Polymerisation

Evaldas Balčiūnas[1,2,3], Daiva Baltriukienė[1], John G. Hardy[2,3]

1 - Department of Biological Models, Life Sciences Centre, Vilnius University, Lithuania
2 - Department of Chemistry, Lancaster University, United Kingdom
3 - Materials Science Institute, Lancaster University, United Kingdom

Laser multiphoton polymerisation is a 3D printing technique for producing sub-micrometer objects with unprecedented precision and reproducibility. The technique opens possibilities to tailor scaffolds for tissue engineering [1], photonics elements [2], microfluidics [3] and other structures directly from CAD software. The chemical and physical properties of the printed materials play a key role in their functionality, which motivates the generation of materials with diverse and tunable properties. Here, we present an aluminium-based hybrid organic-inorganic material that is relatively simple to prepare, tune and structure in 3D.

The aluminium hybrid was prepared by dissolving aluminium isopropoxide in toluene and subsequently adding methacrylic acid and HCl- hydrolised 3-methacryloxypropyltrimethoxysilane (MAPTMS). 4,4′-bis(diethylamino)benzophenone was used as a photoinitiator at 1 % w/w. After drop-casting on a glass slide, the material was polymerised using a Nanoscribe 3D lithography system, washed with toluene, air dried and characterised by a variety of techniques. The biocompatibility of the material was assessed by growing mouse fibroblasts on spin-coated films that were polymerised upon exposure to UV light.

An array of structures was fabricated by varying the power and scanning speed of the laser. We observe that fabrication of the material is incredibly straightforward in both simple 2D and complex 3D structures to be fabricated with ease (indeed, resolution tests show that suspended lines with widths of less than 200 nm could be fabricated). The material supported cell adhesion and proliferation (supporting its low toxicity *in vitro*).

We believe that the material described in this work, shows promise for the development of objects with sub-micron features, for example as scaffolds for tissue engineering.

[1] Ovsianikov et al. Expert Review of Medical Devices 2012; 9(6): 613-633.
[2] Scrimgeour et al. Advanced Materials 2006; 18: 1557-1560.
[3] Kumi et al. Lab on a Chip 2010; 10: 1057-1060.