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Design of scaffold morphology for optical cell differentiation using novel polymerisation techniques

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INTRODUCTION: The physical and chemical properties of a scaffold influence a cell's bio-activity. By engineering the materials of the scaffold, it can exhibit the best imitation of the natural extracellular environment to provide optimum conditions for cell adhesion and differentiation. In this study, we employ *in-situ* polymerisation to produce a specialized 3D polylactic acid cell-scaffold structure using Mg/Al layered-double-hydroxide (CO_3^{2-}) as the initiator without using potentially toxic catalysts.

METHODS: The initial hybrid product is prepared by the reaction of 95% L,D-lactide by mass and 5% LDH by mass at 150 °C for 24 h. The ring structure of the L,D-lactide is opened by the carbonate-intercalated LDH initiator to form a poly(lactide) / Mg lactate ionomer complex. Then methylene chloride (CH_2Cl_2) is used to extract soluble poly(lactide) from the polymer product by centrifugation at 8000 rpm for 10 minutes leaving the insoluble scaffold phase. Finally, the insoluble component is heated in air for 12 h to fully remove the solvent.

RESULTS: A selection of SEM images (Fig. 1) was taken to examine the microstructure and morphology of the porous-structured scaffold material, which remained after extraction from the hybrid polymerization products. A porous structure is visible, indicating that polymerising L,D-Lactide with a carbonate-intercalated hydrotalcite as an initiator can synthesis a porous structure. By inspection, the structure is quite heterogeneous in terms of having a wide pore size distribution. As a consequence, the mean pore size was difficult to calculate properly. However, with the help of micro CT, we can learn more about the whole structure about the scaffold in future, e.g., porosity, pore size, interconnectivity.

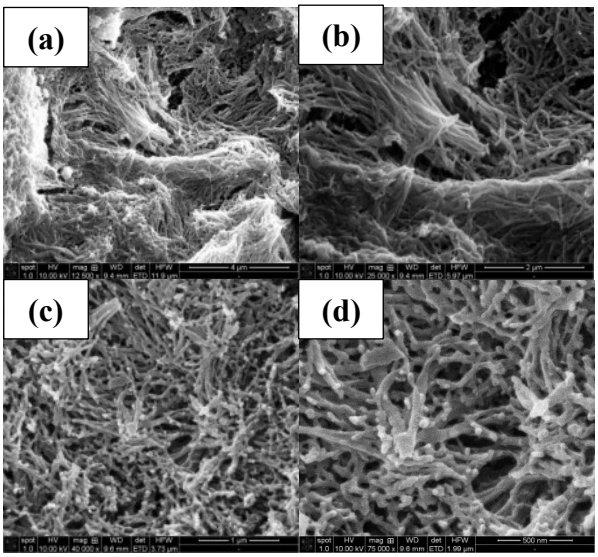

Fig. 1: SEM micrographs of Poly(L,D-lactide) / magnesium lactate scaffold with 5% LDH (CO_3^{2-}) concentration at magnifications of (a) ×12.5K (b) ×25K (c) ×40K(d) ×75K.

DISCUSSION & CONCLUSIONS: This study has confirmed the formation of a porous structure suitable for a potential cell-growth scaffold. It was chemically identified as a poly(L,D-lactide) / magnesium lactate complex [1] using XRD. For future work, other lactone monomers can be applied for the copolymerization (e.g. caprolactone and valerolactone). Further material characterization will include NMR (Nuclear Magnetic Resonance Spectroscopy) and AFM (Atomic Force Microscopy) Based on the scaffold morphology, it is expected that osteoblast (bone) cells could be seeded *in-vitro* on the scaffold. Then, PicoGreen and Alamar Blue Assay can be used to test the biocompatibility of the scaffold, by indicating the distribution of live cells across the material.

REFERENCES: [1]J.V. Smith, A.S. Beward, etc. (1996). *X-ray powder data file, sets 1-5.* ASTM Special Technical Publication pp. 16.