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Biomimetic polyurethane scaffolds for a stem cell based therapy in myocardial regeneration

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Scaffolds for myocardial Tissue Engineering (TE) should display biomimetic properties respect to cardiac extracellular matrix (ECM), including elastomeric properties. Cardiac regeneration depends on cardiac progenitor cells (CPCs) as well as the milieu in contact with them. Laminin-1 (LN1), typical of developing heart and over-expressed in pathological heart, promotes CPC proliferation and viability. In this work, a thermoplastic polyurethane (PU) was synthesized from poly (ε-caprolactone) diol (Mn = 2000 Da), 1, 4-budandiisocyanate and L-lysine ethyl ester dihydrochloride. Bi-layered scaffolds with 0°/90° lay-down pattern were prepared by additive-manufacturing technique. Functionalisation with LN1 or gelatin (G) was performed in two steps: 1) acrylic acid grafting/polymerization by Argon plasma treatment; 2) carbodiimide-mediated coupling of proteins. Scaffolds with mean fibre diameter of 152±5 μm and mean spacing of 505±5 μm were prepared. FITR-ATR analysis of protein-coated scaffolds showed higher intensity of the absorption bands at 3370 cm-1 (-OH and –NH stretching) and 1650 cm-1 (amide I). Contact angle decreased from 90° for PU to 60-65° after G- or LN1-grafting. XPS analysis confirmed acrylic acid grafting/polymerization and protein conjugation. Scaffolds were degraded *in vitro* by lipase (0.3 mg/ml) in 3 weeks. CPC proliferation on PU-LN1 scaffolds was higher than on PU and PU-G scaffolds, increasing from 8.18% on day 7 to 11.8% on day 14. LN1-functionalization stimulated CPC differentiation into cardiomyocytes and endothelial cells.

Biography

Valeria Chiono has a Master Degree in Chemical Engineering summa cum laude (2001) and a PhD in Chemical and Materials Engineering from the University of Pisa (2006). She is currently Associate Professor at the Department of Mechanical and Aerospace Engineering, Politecnico di Torino. She is coordinator of the national FIRB Project "Bioartificial materials and biomimetic scaffolds for a stem cells-based therapy for myocardial regeneration" and of the project "Smart Injectable Drug-Delivery systems for Parkinson's and Alzheimer's Disease Treatment". She has collaborated in several national and international projects. She is currently author of 40 manuscripts in international journals and 4 patents.

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