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Synthesis of low-cost polyhedral networks from vitreous carbon: Process parameters and orthopedic applications

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Carbon based porous materials are usually fabricated from phenolic resins because of their relatively high carbon yield, although sucrose-based resins could be used as an alternative that offers a low-cost and more environmentally friendly process for the preparation of the carbon precursor. Recently, a few studies have shown the potential of reticulated vitreous carbon foams (RVC) for bone tissue regeneration applications. It appears that RVC foams could provide a permanent material platform to guide bone remodeling at the defect site. Nonetheless, one of the major limitations associated with the use of RVC foams for bone repair lies in their low mechanical properties. One way to circumvent this issue is through the reinforcement of the carbon foam with a phase that would allow it to withstand mechanical loading in vivo, while still preserving the morphology and pore size levels that favor osteogenic cell infiltration and proliferation (200-500 µm). The main goal of the present work was to develop vitreous carbon polyhedral networks that show morphological features that resemble trabecular bone, and have cell sizes ~1 mm, in order to eventually allow the mechanical reinforcement of such scaffolds using a biomaterial coating without compromising the pore size that favors osteoblast cell infiltration and growth. Toward this goal, vitreous carbon networks were fabricated via template route using a sucrose resin and cellulose foams that were recycled from common fish tank filters were used as the sacrificial polymeric template. The results showed that the synthesized carbon networks had similar structural properties to expensive, commercial RVC foams. Moreover, carbonization conditions had an effect on the mechanical properties of the foams and therefore, such variables warrant further investigation towards the enhancement of the mechanical resistance of RVC scaffolds that could be used as the porous component of a synthetic graft for bone defect repair.

Biography

Viviana Guiza-Arguello has received her PhD in Chemical Engineering from Texas A&M University in 2013 followed by a Post-doctoral study in the Center for Biotechnology and Interdisciplinary Studies (CBIS) at Rensselaer Polytechnic Institute in Troy, NY. She is currently appointed as a Post-doctoral Research Associate in the Metallurgical Engineering and Materials Science Department at Universidad Industrial de Santander, Colombia. Her research interests include the development of composite scaffolds for bone regeneration and the use of polymers in tissue engineering as well as in the decontamination of industrial waste water.

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