Insight Medical Publishing

Archives in Chemical Research

ISSN 2572-4657

2020

Vol.4 No.5

Synthesis and characterization of hybrid cellulose-silica aerogels reinforced with collagen to be used as scaffolds in biomedical applications

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Abstract

Cellulose-silica aerogels are fascinating materials featuring high porosity, low density andbiocompatible properties that can be useful in many biomedical applications. However, their lack ofsufficient mechanical stability makes them inappropriate for some purposes. In our effort to producemore durable and stronger aerogels and to improve their absorption capacity, hydrolysed collagenwas used as a reinforcing agent. Collagen and cellulose were integrated into silica networks bymeans of the sol-gel process and then dried in supercritical conditions using CO2. Different amountsof cellulose and collagen were employed, and Ca(NO3)2·4H2O and KH2PO4 were added to inducethe production of hydroxyapatite. Structural characterization tests (uniaxial compression, BETmethod, TGA curves, FTIR analyses, and SEM) conducted on the collagen-cellulose-silica aerogelsshowed that their compressive properties greatly exceed those of plain cellulose aerogels, and that,unlike the latter, the former exhibited elastomeric behaviour. Their absorption capacity propertieswere also measured by immersing them in simulated body fluid (SBF). Results proved that thestable structure and effective swelling of cellulose aerogels improved significantly by the use ofcollagen (swelling ratio from 80 to 96 %). Finally, the bioactivity of scaffolds was evaluated byexamining the formation of a biologically active carbonate apatite layer on its surface afterimmersion in SBF. These promising results led us to carry out cell adhesion/attachment tests, whichrevealed the presence of osteoblast cells on the scaffolds' surface. We can conclude that theprepared cellulose/silica aerogels may be used as tissue engineering scaffolds.

Biography: Dr. María del Mar Mesa graduated in Chemistry and completed her doctorate in ChemicalEngineering at the University of Cádiz (Spain) in 1998. She then applied for a posdoctoral positionat the University of Geneva. Having lectured in the Department of Chemical Engineering and FoodTechnologies at the University of Cádiz for several years, Dr. Mesa took the position of assistantprofessor in 2004. Her research activity has primarily focused on bioprocess engineering, and iscurrently working on the design and preparation of polymeric scaffolds with potential applicationsin tissue engineering using sol-gel techniques.

Speaker Publications:

1. "Viability Reduction of Acetobacter aceti Due to the Absence of Oxygen in Submerged Cultures" September 2008Biotechnology 709 - 712
2. "System for indirect H2S removal using iron-oxidizing bacteria: The scale up process of a pilot plant" Journal of Bio TechnologyJan 2006.
3. "Biological oxidation of ferrous iron: study of bioreactor efficiency."; Journal of the chemical technology and Bio Technology vol-79, issue 2, pg-162-173, 2004
4. "Use of the Direct Epifluorescent Filter Technique for the Enumeration of Viable and Total Acetic Acid Bacteria from Vinegar Fermentation"; Journal of Flurosence/ Vol 13, 2003.

5. "Mathematical Model of the Oxidation of Ferrous Iron by a Biofilm of Thiobacillus ferrooxidans"Journal of BioTechnology progress / Vol 18, 2002 Isuue-4, Pages 679-685

7th World Congress on Chemical Engineering and Catalysis Webinar– July 22-23, 2020

Abstract Citation:

M. M. Mesaa, Synthesis and characterization of hybrid cellulose-silica aerogels reinforced with collagen to be used as scaffolds in biomedical applications, Chemical Engineering Congress 2020, 7th World Congress on Cemical Engineering and Catalysis-Webinar July 22-23, 2020.

(https://chemicalengineering.annualcongress.com/abstract/2020/synthesis-and-characterization-of-hybrid-cellulose-silica-aerogels-reinforced-with-collagen-to-be-used-as-scaffolds-in-biomedical-applications)