Ionic-Complementary Peptide-Carbon Nanotube Nanocomposite Hydrogels

+[1, 2]Sheikholeslam, M; [1]Pritzker, M; [1, 2]Chen, P
+[1]Department of Chemical Engineering, [2]Waterloo Institute for Nanotechnology, University of Waterloo, 200 University Avenue West, Waterloo, Ontario N2L 3G1, Canada

Introduction:

Electrical conductivity is an essential characteristic for some of the tissues in the body including cardiac and neural tissues. So in designing and making scaffold to regenerate the mentioned tissues this aspect of tissue should be addressed. Here we demonstrate a two-step procedure to produce hydrogels consisting of carbon nanotubes modified by an ionic-complementary peptide as potential scaffolds for tissue engineering.

Materials and Methods:

In the first step, multi-walled carbon nanotubes (MWNTs) are immersed in an aqueous solution containing the ionic-complementary peptide EFK8 and are non-covalently modified through hydrophobic interactions between the hydrophobic residues of EFK8 and the MWNT sidewalls. In the second step, the suspension was added to an EFK8 solution (as the main scaffold material) and mixed very well. This suspension is then formed nanocomposite peptide-CNT hydrogel upon adding a media with a salt concentration of > 1 mM.

Results and Discussion:

Dynamic light scattering, zeta potential measurement, AFM, SEM and TEM examination of the suspension after the first step confirm that it contains individual MWNTs that are well dispersed and remain very stable for long periods of time. Also, tissue culture plates modified with these EFK8-modified MWNTs exhibit enough biocompatibility for attachment and growth of cells. Electrical conductivity measurements using an electrometer and a four-point probe confirmed that the presence of MWNTs in the gel structure leads to an increase in its electrical conductivity. The elastic shear modulus (G) of the gels is also shown to increase as a result of MWNT incorporation. This enhanced electrical conductivity of the peptide hydrogels opens up their use in a number of potential biomedical applications involving tissues which propagate electrical signals such as cardiac muscles and neural tissues, as well as in the design of bio-electrode interfaces and fabrication of biosensors with high sensitivity.