

Nanotechnology, Cell Culture and Tissue Engineering

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Abstract

We have fabricated new types of polymer hydrogels and polymer nanocomposites, i.e., nanocomposite gels (NC gels) and soft, polymer nanocomposites (M-NCs: solid), with novel organic/inorganic network structures. Both NC gels and M-NCs were synthesized by in-situ free-radical polymerization in the presence of exfoliated clay platelets in aqueous systems and were obtained in various forms such as film, sheet, tube, coating, etc. and sizes with a wide range of clay contents. Here, disk-like inorganic clay nano particles act as multi-functional cross linkers to form new types of network systems. Both NC gels and M-NCs have extraordinary optical and mechanical properties including ultra-high reversible extensibility, as well as a number of new characteristics relating to optical anisotropy, polymer/clay morphology, biocompatibility, stimuli-sensitive surfaces, micro-patterning, etc. For examples, the biological testing of medical devices, comprised of a sensitization test, an irritation test, an intracutaneous test and an in vitro cytotoxicity test, was carried out for NC gels and M-NCs. The safety of NC gels and M-NCs was confirmed in all tests. Also, the interaction of living tissue with NC gel was investigated in vivo by implantation in live goats; neither inflammation nor condescence occurred around the NC gels. Furthermore, it was found that both N-

NC gels consisting of poly (N-isopropylacrylamide)(PNIPA) /clay network and M-NCs consisting of poly(2-methoxyethylacrylate)(PMEA)/clay network show characteristic cell culture and subsequent cell detachment on their surfaces, although it was almost impossible to culture cells on conventional, chemically-cross linked PNIPA hydrogels and chemically crosss linked PMEA, regardless of their crosslinker concentration. Various kinds of cells, such as humanhepatoma cells (HepG2), normal human dermal fibroblast (NHDF), and human umbilical vein endothelial cells (HUVEC), could be cultured to be confluent on the surfaces of N-NC gel or dried N-NC gels and M-NC film, regardless of their thickness. Also, it was found that cells cultured on the surfaces of N-NC gels and M-NCs could be detached in the forms of sheets of cells or single cells without trypsin treatment, but by just decreasing the temperature to 20°C. Thus, the serious disadvantages (intractability, mechanical fragility, optical turbidity, poor processing ability, low stimulus sensitivity, etc.) associated with the conventional, chemically-cross linked polymeric materials were overcome in NC gels and M-NCs. Also, NC gels and M-NCs can be used as new types of substrata with ability of cell culture and subsequent thermo responsive cell detachment.