

Preparation Of Smart Material From Polymer-Grafted Carbon Micro-Coils And Thermo-Sensitive Polymer Gel

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{Introduction}

Carbon micro coil (CMC) is a carbon fiber with helical structure and has high grade mechanical and electrical properties. It has also reported that CMC was generated heat with electromagnetic irradiation. For the high-grade composite material of CMC and polymer matrix, it has required that modification of CMC surface with polymer. In this study, we demonstrated the surface modification of CMC with grafting polymers onto CMC and prepared composite smart material of poly(*N*-isopropylacrylamide) (PNIPAM) gel as thermo-sensitive polymer gels containing CMC by photo-polymerization. This composite smart material would change its volumes by internal thermo-energy by CMC with electromagnetic irradiation. The properties of the material such as content of carbon micro-coils, swelling ratio, breaking strength, and thermo-sensitivity were evaluated.

{Experimental}

PNIPAM were grafted onto CMC with radical polymerization. The composite gels were prepared by photo-polymerization with irradiation of ultraviolet light. *N*-isopropylacrylamide, monomer, *N,N'*-methylenebisacrylamide, crosslinker, 2,2'-Azobis(2-amidinopropane)dihydrochloride, and initiator were dissolved in water. Untreated CMCs and PNIPAM-grafted CMC were added this solution with stirring, respectively. The gelation was carried out by irradiating with ultraviolet light for several hours. Content of CMC was calculated with thermogravimetric analysis (TGA). Swelling ratio was calculated from weight of swollen gel and that of dry gel. Breaking strength was evaluated by compression test. Thermo-sensitivity and function as drug carrier were evaluated by relationship between temperature and volume alteration modulus.

{Results and Discussion}

The amount of grafting polymers onto CMC was increased with polymerization time until 24hours and dispersion of CMC in water and organic solvent was significantly improved by grafting polymer onto CMC. The black colored composite gel membranes were prepared by this method, and polymer-grafted CMC were uniformly dispersed in PNIPAM gels. It was estimated that grafted polymers augmented hydrophilic of CMC, and CMCs were dispersed in the polymer network which contained water solution. Composite gels had slightly larger swelling ratio and smaller breaking strength than normal PNIPAM gel. Composite gels were changed their volume with temperature alternation as same as normal PNIPAM gel, and showed phase transition temperature at 35 °C. During the shrinking process of composite gels, no CMC was eluded from composite gels. These results suggested that CMC was entrapped polymer matrix very well and the composite gels maintained its thermo-sensitivity to shrink with heat.

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