FUNCTIONAL NANOCOMPOSITES BASED ON BACTERIAL CELLULOSE

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Bacterial cellulose (BC) is a fermentation product using a medium containing glucose and Gluconacetobacter xylinus. In most cases, BC is obtained as a hydrogel form. In comparison to plant-derived cellulose, BC has several interesting characteristics such as nano-sized network structure, high purity, high crystallinity and high moisture content (around 99%). Additionally, BC with layered structure is formed under static culture conditions. This study provides a new strategy to prepare functional composites containing BC, which have characteristic functions based on BC.

We have developed one-dimensional swelling-shrinkage of a dried sheet of BC-poly(sodium acrylate) nanocomposites in water. The nanocomposite was readily synthesized by the polymerization of sodium acrylate and acrylic acid with \(N,N'\)-methylenebisacrylamide in the presence of BC hydrogel and the dried sheet was obtained by drying the nanocomposite at heating. When the sheet was immersed in water, the thickness of the sheet extensively changed in comparison with the horizontal size. The vertical swelling ratio of the composite sheet against the horizontal one reached maximum 5, and the swollen sheet shrunk to the original shape by drying under vacuum. This swelling-shrinkage cycle could be repeatedly conducted.

BC/polyacrylonitrile (PAN) monolith composite (BC-PAN) was prepared by solvent-exchange of BC gel and phase separation of PAN. BC-PAN had 3D-3D interconnected porous structure in the BC layer. Hierarchically 3D-structural carbon was prepared from BC-PAN and applied for electrodes of electric double layer capacitors (EDLCs). The unique structure of BC-PAN gave good EDLC behaviors without a conductive agent.

Keywords: bacterial cellulose, composite, monolith, electric double layer capacitor