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Controlled micelle formation and sol-gel transition in the mixed aqueous solutions of enantiomeric block copolymers of polylactide and poly(ethylene glycol)

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Various block copolymers comprising enantiomeric polylactides (PLLA and/or PDLA depending on the enantiomeric chains) and poly(oxyethylene) (PEG) were prepared to analyze the structural effects on the formation of core-shell nanoparticles in aqueous media. It was found out that the micelle particle structure and stability can be correlated with the position of streocomplex (sc) crystallization inside the micelle cores. This finding gives an insight into the dynamic and static mechanisms of macromolecular aggregation and ordering, particularly, into the process of sol-gel formation in the mixed micellar solution of the enantiomeric PEG-PLA block copolymers. Also, we succeeded in synthesizing several copolymer mixtures of furan-terminated diblock copolymers (F-PEG-PLA) and triblock copolymers (PLA-PEG-PLA) having different compositions by ROP of L- and D-lactides using partially furanylated PEGs as the macro initiators. Each of the copolymer mixtures obtained was dispersed into an aqueous medium to prepare mixed micelle solutions of the enantiomeric copolymer mixtures in the presence and absence of a coupling agent 1,8-bis(maleimido) diethylene glycol (BMG). The BMG-added mixed micelle solutions turned to gel states having higher storage moduli (11 kPa) than their corresponding BMG-free micelle solutions. The former systems were thought to be controlled by the dual cross-linking mechanisms for the gel formation; physically by sc formation between the enantiomeric PLA block chains and chemically by Diels-Alder coupling between the furanyl terminals on PEG blocks and BMG. These sol-gel systems are not only interesting in terms of tuning the self-assembling micelle formation and sol-gel transition but also promising to provide injectable scaffolds in the tissue engineering.

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Nanocrystalline Cu2O/p-Si solar light-responsive Schottky photodiode

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Nanocrystalline of Cu2O thin film was synthesized by sol–gel spin-coating technique. The spectrophotometric characteristics of transmission and reflection were studied for the film deposited on glass substrate. The optical absorption measurements near the absorption edge indicate that the absorption mechanism is due to allowed direct transition with energy gap value of 2.09 eV. The current–voltage characteristics of Al/Cu2O/p-Si/Al diode were studied under dark and various light intensities in the range 20–100 mW/cm2. The main diode parameters such as barrier height, ideality factor and series resistance were calculated from the analysis of current–voltage characteristics and studied under various illumination intensities. Moreover, the results indicate that the diode has a high photoresponsivity and the photocurrent increases with increasing light intensity which supports the availability of the diode for photosensor applications. The capacitance and conductance characteristics indicate that the diode highly depends on both voltage and frequency. Higher increase in the capacitance under low frequency as well as the presence of a characteristic peak in the capacitance–frequency characteristics indicates the presence of interface states. Moreover, the stronger parameters of the diode performance such as series resistance and interface states were extracted from the capacitance–voltage–frequency and conductance–voltage–frequency characteristics.

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