Synopsis of Original Research Paper

Self-Assembled Nanosheet Composed of Cyclic Oligosaccharides: Drug loading and release properties and adhesion behavior

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We recently reported the formation of a pseudo-polyrotaxane nanosheet (PPRNS), which possesses a self-assembled nanosheet structure bearing a pseudo-polyrotaxane (PPR) consisting of β-cyclodextrins (β-CDs) and a carboxyl-terminated poly(ethylene oxide)$_{75}$-*b*-poly(propylene oxide)$_{29}$-*b*-poly(ethylene oxide)$_{75}$ triblock copolymer ($EO_{75}PO_{29}EO_{75}$-COOH). In this study, we investigate the ability of PPRNS to load fluorescent probes, the dissolution mechanism of PPRNS into solvent by heating, and the adhesion behavior of PPRNS to uneven material surfaces. The fluorescent probes without methyl groups were not absorbed by PPRNS. These results indicate that PPRNS has a molecular recognition property based on the host−guest interaction of the functional groups on probe molecules and molecular-sized spaces of PPRNS surfaces, which may be vacant β-CDs and voids between β-CD columns. The dissolution mechanism of PPRNS was investigated from the viewpoint of crystallinity, particle morphology, and PPRNS concentration through proton nuclear magnetic resonance spectroscopy, scanning electron microscopy, and X-ray scattering analysis. The results revealed that the PPRNS dissolved in two steps during heating. First, β-CDs of the PPRNS de-threaded from the axis and the PPRNS dissolved in the out-of-plane direction thinned while maintaining the rhombic structure. Upon further heating, both β-CD and the PPR dissolved, collapsing the rhombic structure of the PPRNS in the in-plane direction—this occurred upon the melting of the β-CD crystals of the PPRNS—thereby achieving an amorphous state. Finally, we could achieve observing the adhesion behavior of PPRNS to the Blu-ray disk substrate (1D bending), polystyrene spherical beads (2D bending), and random rough surface of pork skin. In the future, we will further elucidate the basic mechanism, investigate molecular loading and sustained-release capabilities, and discover the potential of this material as DDS material.