総 説 論 文

微生物分子の構造を基盤とする超高性能バイオプラスチックの分子設計

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Molecular Design of Super-high Performance Bioplastics Based on Structures of Microbial Molecules

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High-performance bioplastics are indispensable for establishment of sustainable green society. However the conventional bioplastics were not distributed very widely due to the low thermomechanical performance and no specific functions. Here we propose new synthetic routes for high-performance bioplastics such as biopolyamides and biopolyimides. As for biopolyamides, a biomonomer itaconic acid (IA) is used, which is mass-produced by the fermentation of *Aspergillus terreus*, to form rigid N-substituted pyrrolidone ring in the polyamide backbone via salt-type monomers composed of diacidic IA and diamines. The polyamides show higher thermomechanical performance than those of conventional polyamides, and show solublility in water by ring-opening reaction of the pyrrolidone induced by landfill or ultraviolet-irradiation. Next we prepared one of the highest performance polyimides from microbial resources. We develop bioavailable aromatic diamines, which are photodimers of 4-aminocinnamic acid (4ACA) derived from genetically-manipulated *Escherichia coli*, and polymerize it to form the corresponding polyimide films. The biopolyimide films show ultrahigh thermal resistance with T_{10} values over 425℃ and no T_g values under 350℃, which is the highest value of all bioplastics reported thus far. The PI films also show high tensile strength, high Young's moduli, good cell compatibility, excellent transparency, and high refractive indices.

Key Words : aromatics, polyimides, polyamides, bioplastics, photoreactions