

Supertough Fibers of Itaconic Acid-Derived Bionylon Composites with Polyamide 11

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Building a low carbon society, as well as biodegradation of plastics, are the biggest concern. Itaconic acid (IA), which is a bio-derived substance has one double bond and two carboxylic acids, reacted with diamines to produce bionylon plastics degradable in water under the UV irradiation. Michael addition of IA with diamine followed by ring-closing amidation formed a polyamide having a pyrrolidone ring in the main chain. In addition, bionylons from IA and hexamethylene diamine (HMDA) has shown the comparable mechanical strength to conventional nylons (1). However, there is a problem that these bionylons have poor processability. In this study, in order to improve the processability of this bionylon, 11-aminoundecanoic acid (AUA), which is a monomer of nylon 11 which is derived from natural castor oil, was copolymerized with IA and HMDA.

Under a fixed molar ratio of IA and HMDA (1:1), AUA was added as a third monomer in various proportions. Crystalline salt monomers were successfully synthesized in a high yield over 90 wt% even for complicated composition. The obtained salt monomers were heated in the presence of catalyst (sodium hydrogen phosphate, 0.1 wt% of the total amount) and stirred at 220 °C, which was set over 5 °C higher than dehydration temperature of the salt monomers by thermogravimetry, under a nitrogen atmosphere for 6-8 hours. Fibers were formed as shown in Fig. 1 by melt-spinning. As a result of the tensile test of the fibers, the value of the strain at break increased with the increase in the amount of AUA. Thus, bionylon fibers having high toughness were produced. Further, photo-induced hydrolyses were tested on these fibers to enhance water affinity upon the application of the UV light as shown in Fig. 2, differently from photooxidation. In this report, enzymatic degradation of bionylon resins will be discussed.

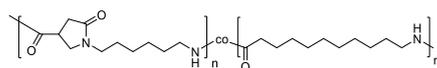


Fig. 1. Fiber and film from AUA Bionylon



Fig. 2. Photo degradation of AUA Bionylon film under UV light

1) M. A. Ali, S. Tateyama, Y. Oka, M. Okajima, D. Kaneko, T. Kaneko, *Macromolecules* 2013, 46(10), 3719–3725.