Abstract

「植物由来ポリアミドの機械的およびトライボロジー的性質の高性能化に関する研究」

Study on Enhancing the Mechanical and Tribological Properties of Plant-Derived Polyamide

Doctor Course, Mechanical Engineering, Graduate School of Engineering, Kogakuin University

AD21004 Maiko Morino

Supervisor: Prof. Yosuke Nishitani

To develop new polymeric engineering materials based on biomass polymer with performance applicable to actual functional products, this study aimed to investigate the enhancement of the mechanical and tribological properties of plant-derived polyamide 1010 (PA1010) using material design and polymer processing techniques. Specifically, this study investigated the influence of five types: (i) surface treatment of natural fiber, (ii) type of natural fiber, (iii) gamma-irradiation dose and the addition of the cross-linking agent (TAIC), (iv) content of TAIC, and (v) screw configurations in a twin-screw extruder on the mechanical and tribological properties of plant-derived PA1010. Mechanical properties (strength, modulus and hardness) and tribological properties (specific wear rate and limiting *pv* value) of hemp fiber reinforced plant-derived PA1010 (HF/PA1010) biomass composites improved surface treatment using epoxy resin. This surface treatment with epoxy resin was also effective in modifying the mechanical and tribological properties of natural fiber systems other than hemp fiber systems. In particular, ramie fiber was the most effective natural fiber system for enhancing the mechanical and tribological properties of natural fiber reinforced plant-derived PA1010 biomass composites. On the other hand, the combination of the gamma-irradiation and the addition of TAIC strongly influenced the mechanical and tribological properties of plant-derived PA1010. This may be attributed to the change in the internal microstructure (formation of crosslinking structures, change with crystalline and amorphous phases) with the gamma-irradiation and addition of TAIC. Especially, mechanical and tribological properties of gamma-irradiated PA1010 containing 2 wt. % TAIC were the most suitable for enhancing these properties with sufficient balance. Moreover, modification of the screw configurations has a stronger influence on the mechanical and tribological properties of HF/PA1010 biomass composites. Combining these findings, which enhanced using material design and polymer processing techniques, mechanical and tribological properties of plant-derived PA1010 were better performance than those of petroleum-derived engineering plastics.