論 文 の 内 容 の 要 旨

論文題目　Various production methods for improving mechanical properties of discontinuous recycled carbon fiber sheet reinforced thermoplastics
(不連続リサイクル炭素繊維シート強化熱可塑性樹脂の力学特性改善のための種々の製造法)

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With the booming development of artificial intelligence, electrification and sharing economy, except the concepts of lightweight, durability and design, repairable, recyclable and reusable material is expected widespread to adapt to modern society and sustainable development. In this research, with the aim of realizing the reuse of recycled carbon fiber (rCF) with its utmost potential and the possibility of providing new service to industry, several manufacturing and processing methods were developed for rCF reinforced thermoplastics (rCFRP) experimentally and analytically.

When relatively long rCF, for instance, around 50 mm in this study, can be obtained from recycling, exploiting its potential for high mechanical performance would be priority. Therefore, a special carding and stretching process was introduced to make carbon fiber card web reinforced thermoplastics (CWT) sheet with mixing rCF and matrix resin fibers. X-ray micro-computed tomography analysis was performed to evaluate the fiber alignment level. The influence of fiber alignment on the elastic property of CWT is illustrated analytically. The flexural strength of CWT could even reached 862 MPa which is even higher than continuous woven carbon fiber fabric reinforced thermosetting plastic.

The other scenario is that when the length of rCF tends to be short, for example, within

10 mm, usually they would be uniformly dispersed in the plane by nonwoven technology or papermaking technology introduced in this research where it mix short CF and matrix resin fibers to produce carbon fiber paper reinforced thermoplastic (CPT) sheet. But due to short fiber length and random fiber orientation, high mechanical property cannot be expected compared with CWT. Therefore, to solve its weaknesses and find its potential in industry are necessary. Among those weaknesses, one is brittleness which could inferior energy absorption ability and cause safety problems. Therefore, we used aramid fiber which has high ductile feature to hybridize with short rCF and made hybrid carbon fiber/ aramid fiber thermoplastics successfully. The energy absorption ability reached around 4 times higher than pure CPT. With optimal laminated structure, the toughness of hybrid was improved without sacrificing its stiffness. Another problem is the severe deconsolidation phenomenon (spring-back) when CPT is subjected to post thermal processing, which may cause structure useless. Therefore, the idea of using CPT as core material in sandwich structure was proposed. The spring-back core sandwich with no obvious delamination and extremely high specific mechanical property was made successfully. The density of the sandwich could be even lower than that of water, which indicates the various possibilities of it in the near future.