論 文 の 内 容 の 要 旨

論文題目　Dynamic and Viscoelastic Behavior of Discontinuous Carbon Fiber Reinforced Thermoplastics

（不連続炭素繊維強化熱可塑性樹脂複合材料の動的特性および粘弾性に関する研究）

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Carbon fiber reinforced thermoplastics (CFRTP) are gaining popularity in the automotive industry in harmony with growing demand for lightweight vehicles. Two types of CFRTP, chopped carbon fiber tape reinforced thermoplastics (CTT) and carbon fiber mat reinforced thermoplastics (CMT), are developed to manufacture the automotive components. This research is mainly aimed at characterizing the dynamic and viscoelastic behavior of CMT and CTT theoretically and experimentally in depth.

Because the thermoplastic matrix (i.e., polypropylene or polyamide 6) presents remarkable viscoelasticity, the mechanical properties of CMT and CTT exhibit significant temperature and strain rate dependence. The interfacial shear strength (IFSS) between carbon fiber and matrix drops rapidly over the glass transition temperature of the matrix resin. Consequently, the critical tape length for CTT increases with elevating temperature. CTT composed of shorter tapes show more distinct temperature dependence than CTT constituted of longer tapes. By introducing the innovative concept of equivalent tape aspect ratio, the temperature dependence of CTT can be accurately predicted via the micromechanical homogenization theory, or rather, Mori-Tanaka method. With respect to strain rate dependence, Both CTT and CMT present log-linear relationship between in-plane Young's modulus and strain rate.

In addition, in order to determine the transverse shear and flexural moduli of in-plane quasi-isotropic CMT and CTT, the Timoshenko beam theory and vibration test are used to determine the moduli quickly. Finally, the nondestructive inspection for CFRTP with different kinds of defects (e.g., delamination, resin-rich, and voids) is performed by using tapping test divided into global and local methods. And the simplified mathematical expressions of local responses (i.e., contact duration and peak of interactive force) are derived to identify defects accurately.