Anisotropic Thermal Diffusivity Measurements in High Thermal Conductive CFRP Composites

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In terms of designing recent spacecraft, lighter and high-end thermal devices are required. As for radiators, it is proposed to apply pitch-based carbon fiber reinforced plastics (CFRPs) as the base material, since the pitch-based carbon fibers have high thermal conductivities. The CFRPs have large anisotropy depending on the direction of the carbon fibers, and are used over a wide temperature range. This paper presents the temperature dependence of in-plane thermal diffusivity and distribution of anisotropy of the pitch-based CFRPs. The principle of the measurement is based on the laser-spot-periodic-heating-method. The thermal diffusivity is obtained by measuring the distance dependence of the phase difference between periodic heat input and ac temperature of a sample. The position of the laser spot is controlled by moving the sample with a XY-Stage. The ac temperature is detected by a thermocouple, where the junction is attached on the center of the rear surface of the sample. Two kinds of samples, one unidirectional (UD) and the other quasi-isotropic (QI), were fabricated using an autoclave. UD samples contain fibers in only one direction. QI samples contain fibers in two directions. As for the temperature dependence of thermal diffusivity measurements, we have scanned the laser linearly through the thermocouple. As for the distribution of anisotropy measurement, we have scanned the laser in a circle, in a regular pattern of radius and angle. The value of thermal diffusivity becomes high at lower temperatures. The anisotropic ratio is from 208 to 248. The anisotropy mapping of the UD CFRP shows a directional dependence of thermal diffusivity. It is found that the thermal diffusivity decreases rapidly with the angle measuring deviation from the fiber direction. The anisotropy mapping of QI CFRP indicates that the QI CFRP is not homogeneous.