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Materials for Electrically Driven Aircrafts: Highly Conductive Carbon-Fiber Reinforced Epoxy Composites

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Abstract : For an electrically driven aircraft, whose engine is based on semiconductors, alternative materials are needed. The avoid hotspots in the materials thermally conductive polymers are necessary. Nevertheless, the mechanical properties of these materials should remain. Herein, the work of three years in a project with airbus and Siemens is presented. Different strategies have been pursued to achieve conductive fiber-reinforced composites: Metal-coated carbon fibers, pitch-based fibers and particle-loaded matrices have been investigated. In addition, a combination of copper-coated fibers and a conductive matrix has been successfully tested for its conductivity and mechanical properties. First, prepregs have been produced with a laboratory scale prepreg line, which can handle materials with maximum width of 300 mm. These materials have then been processed to fiber-reinforced laminates. For the PAN-fiber reinforced laminates, it could be shown that there is a strong dependency between fiber volume content and thermal conductivity. Laminates with 50 vol% of carbon fiber offer a conductivity of 0.6 W/mK, those with 66 vol% of fiber a thermal conductivity of 1 W/mK. With pitch-based fiber, the conductivity enhances to 1.5 W/mK for 61 vol% of fiber, compared to 0.81 W/mK with the same amount of fibers produced from PAN (+83% in conducitivity). The thermal conductivity of PAN-based composites with 50 vol% of fiber is at 0.6 W/mK, their nickel-coated counterparts with the same fiber volume content offer a conductivity of 1 W/mK, an increase of 66%.

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