Editorial corner – a personal view

Electric conductance of carbon/epoxy laminated composites

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For continuous carbon fiber composites, the electric conductance in the fiber direction can be easily calculated using the rule of mixture. The measured result is not so different from the calculated one and the scatter of the measured results is small.

The electric conductance in the transverse direction and that in the thickness direction, however, are not easily obtained by calculations. The values of electric conductance of these directions depend on the contacts between the carbon fibers, for example, when the bundle is twisted, there may be higher electrical conductance in the transverse direction and lower conductance in the thickness direction compared with that of the transverse direction. The reason is that the twisting of the fiber bundle makes a lot of chance of the adjacent fiber contact and the twisting makes small movement of fibers in the thickness direction when the composite structure is cured. This small movement of the fibers causes less fiber contacts between plies.

Unfortunately, the electrical properties are not usually qualified as a specification even for the commercially available composites. This may cause large scatter of the measured results of conductance usually observed in the transverse and in the thickness direction.

Recently several new composites introduce polymer rich layer or dots between the plies to increase delamination strength. This may cause significant decrease of electric conductance in the thickness direction. This may cause another problem. For example, electrical ground is usually taken to the body in automobiles, but when there is significant decrease of electric conductance in the thickness direction, the electric potential difference may exist between the plies in components. This could cause

the induced electric current when the large electric current flows near the automobile surface. Even when the airplane has lightning strike protection system such as copper mesh or copper foil strips, the extremely steep and large electric current of the lightning may cause large electric current in the protection system and the induced electric current flows in the composites.

Unfortunately, there is no qualification specification of the electric conductance in the composites. It is unknown how large is the scatter of the electric conductance in the thickness direction of the components made of carbon fibers. The values depend on fabrication process. Factors affecting the electric conductance in the thickness direction are also unclear.

I believe we should be careful with respect to the electrical conductance of carbon composites. That is not a constant material property especially in the thickness direction. Of course, as discussed in the first part, the conductance in the fiber direction is well controlled. The electric conductance of the laminated composites is completely different from that of metallic materials, and I hope we should do more research of composites on the electric conductance.

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