Lightning Strike Damage of CF/epoxy Composite Laminates with Conductive Polymer Layers

Tomohiro, Yokozeki [1], Vipin Kumar [1], Yu Zhou [1], Takao Okada [2] , Teruya Goto [3] ,
Tatsuhiro Takahashi [3]
[1]*The University of Tokyo, Tokyo, Japan*
[2]*Japan Aerospace Exploration Agency, Tokyo Japan*
[3]*YamagataUniversity, Yonezawa Japan*

Carbon fiber reinforced plastics (CFRPs) are vulnerable to thunder lightning strikes due to their low electrical conductivity and low heat resistance. A lightning strike can damage CFRP structure catastrophically. Most common lightning strike protection (LSP) technology consists of expended metal foils/films on top of composite structures. This technology possesses disadvantages such as increased weight, galvanic corrosion, expensive integration and repair process. In the present study, authors introduce a novel, all-polymeric LSP technology as shown in Figure 1. A doped intrinsic conductive polymer i.e. Polyaniline (PANI) dispersed in a thermosetting cross-linking polymer divinylbenzene (DVB) has been used to prepare an adhesive layer. CFRP structure coated with this new electrically conductive adhesive layer when tested against simulated lighting impulse current of 100 kA demonstrated effective dissipation of the lightning bolt by PANI-LSP, rendering very high safety to the CFRP structure (Figure 2). It is shown that PANI has the capability to make a 3-D conductive network in all directions due to its self-assembling property, which makes it superior compared to its counterpart carbon/metal fillers based LSP technology.

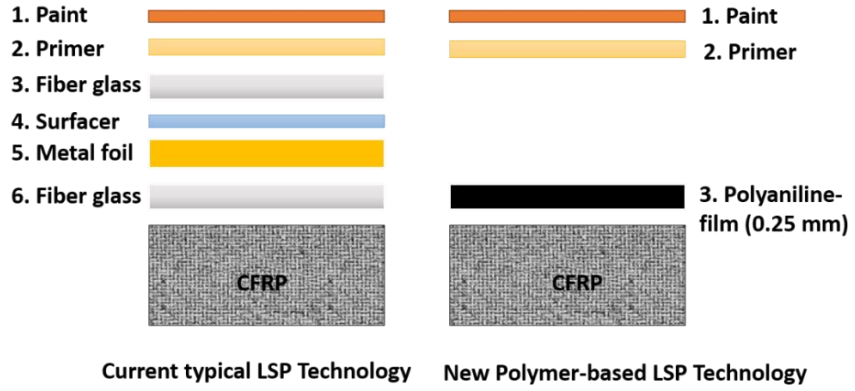

Figure 1. Difference between the current metal-based LSP and the proposed PANI-based LSP technologies.

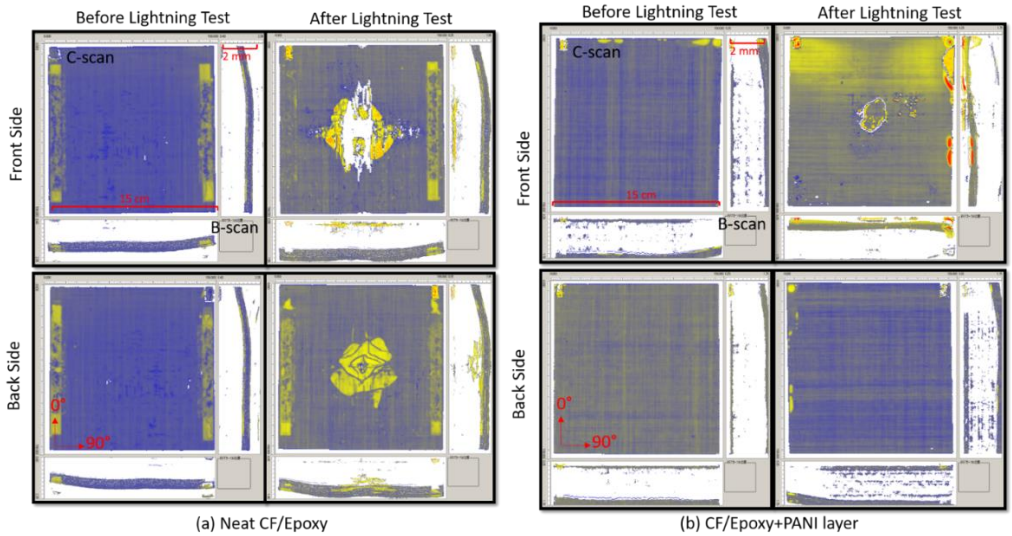

Figure 2. NDI images of CFRP specimen before and after lightning attachment (a) Unprotected CFRPs (b) PANI-layer protected CFRP.