

O74 Dielectric barrier discharge plasma actuators based on thermosetting composites for flow control in wind turbines blades

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Abstract

The massive use of fibre reinforced plastics (FRP) in several industrial sectors such as aeronautics, aerospace, or wind turbines, raises serious environmental concerns with respect to the end-of-life of these structures, based on their poor recyclability. The low density of FRP gives it outstanding specific properties, such as strength and stiffness, when compared to materials with high recyclability rates, such as metals¹. FRP find several applications in structures in which the aerodynamic performance is of extreme importance to guarantee a proper operation. In this sense, to endow these structures with the ability to control or modulate the flow around their surface could be an extraordinary feature to improve the performance of the structure, thus saving considerable amounts of energy and increasing its useful life cycle, contributing in this sense also to reduce the environmental impact of the materials. This work is focused on the development of dielectric barrier discharge (DBD) plasma actuators supported on fibre reinforced thermosetting composites, which can be used in manufacturing of wind turbine blades: epoxy resin and glass, aramid (Fig. 1) and natural flax fibres. DBD plasma actuators are electrohydrodynamic devices capable of generating induced flows of a few m/s through nonthermal plasma, that can be successfully leveraged for flow control applications^{2,3}. The characterization of the system was carried out in terms of mechanical (flexural strength, strain and stiffness), electrical (power consumption, capacitance, charge-discharge cycles) and electromechanical (induced flow velocity, electromechanical power and efficiency) properties. The results showed the multifunctionality of the composites, demonstrating their suitability for the application, in particular, the epoxy/glass composite with a bending stress of ≈ 600 MPa, which obtained an induced flow velocity of ≈ 2.1 m/s with a power consumption of ≈ 15.1 W, when powered by an AC signal of 11 kVpp and 24 kHz.

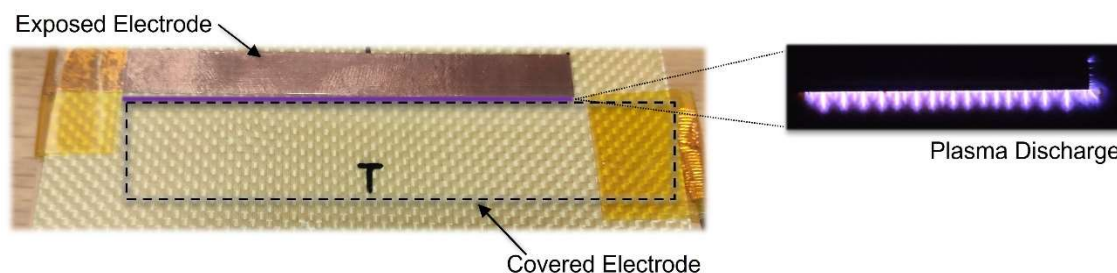


Figure 1. DBD plasma actuator based on aramid fibre reinforced epoxy, with plasma discharge detail (12 kVpp, 24 kHz).

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