

## Graphene based heating mats as anti-icing system on aircrafts

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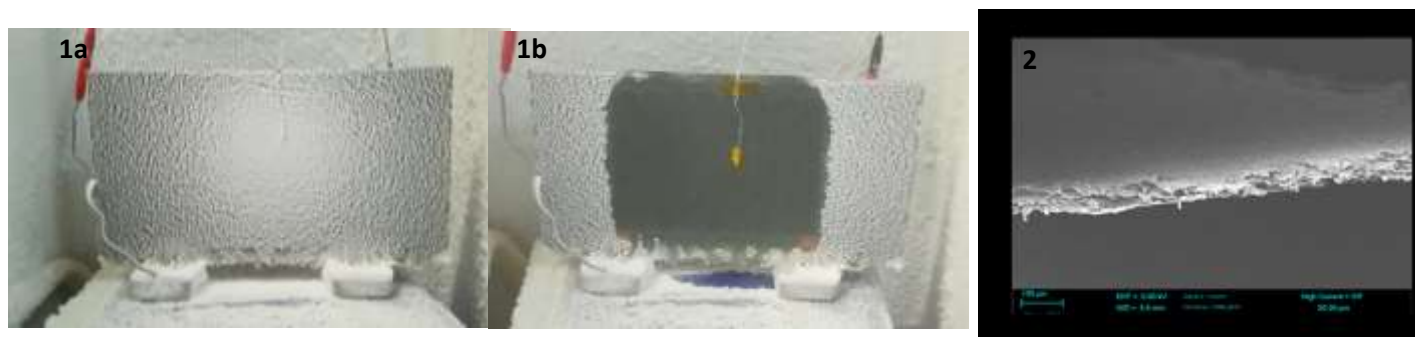
A key target for modern technology is to replace metals with lighter, cheaper, less energy-consuming materials. This “metal replacement” goal is already well established for structural applications in aeronautics and automotive, where the search for higher efficiency and reduced CO<sub>2</sub> emission is pushing toward the use of carbon-based materials (e.g. carbon fiber composites and high-performance polymers), replacing up to 50% of the metal parts of the vehicle [1]. The advantages in the use of carbon-based composite materials does not stop to structural reinforcement and weight loss: carbon based materials such as graphene may help to overcome some limitations in electronic applications as well. Due to its unique properties such as low weight, mechanical strength, thermal and electrical conductivity, graphene could be a promising material for the development of electrothermal heaters for efficient anti/de-icing system in aircrafts.

In this presentation we will show the development of heaters prototypes realized with GRM integrated in Carbon Fiber Reinforced Polymers (CFRP) or flexible substrates with different design and configurations. The devices prepared showed good functionality, uniform heating without hotspots also in bended configuration. Graphene heaters can achieve a wide range of operation temperatures with respect of the system configuration, even capable of melting ice at -30°C in few seconds, showing promising results for anti-icing and de-icing applications.

### References

- [1] Valorosi, Filippo, et al., *Composites Science and Technology* 185 (2020): 107848.
- [2] Blanco-Varela, María Tamara, et al. *Materiales Compuestos* 3.4 (2 019): 22-27.

### Figures



**Figure 1:** Graphene heater integrated in CFRP with ice accretion on the surface **a)** before and **b)** after the de-icing process

**Figure 2:** SEM image of the graphene based material used to fabricate the heating module