Manufacturing and characterization of high electrical conductivity structural epoxy graphene composites

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Glass and carbon fiber fabrics reinforced composites are emerging technologies in last three decades (carbon fiber first emerged in the aviator sector in the 1980s) with structural applications, being an alternative to metallic parts. Structural functions of these types of hierarchical composites are well known and are nowadays used in important sectors, as wind-energy, sports aeronautic and automotive. [1]

Thermosetting carbon fiber fabrics reinforced composites show high electrical conductivity in plane (X-Y directions) while are insulators in through plane (Z-direction). On the other side, glass fiber composites (the 85% of the market) do not have electrical conductivity at any case.

This research aims the preparation of high electrical conductivity, both in plane and through plane, structural thermosetting composites; employing carbon fiber (CF) and glass fiber (GF) fabrics with Highly Reduced Graphene Oxide (HRGO).

We have prepared HRGO-epoxy dispersions and employed them to make glass and carbon fiber fabrics reinforced composites. The fabrics were impregnated with the HRGO-epoxy dispersions and the prototypes were prepared by wet lay-up technique, curing at vacuum conditions. This method constitutes a simple process giving the possibility of obtain structural materials with high electrical conductivity, and take a great advantage in the preparation of many final industrial applications.

Using GF fabrics, more than 1S/m of electrical conductivity is obtained in XY-plane with the addition of 1%w of HRGO in the composite. In Z-axis the percolation limit is achieved with less than 0.6%w.

In case of CF Reinforced Composites (CFRC), with own high electrical conductivity in XY-plane size (5S/m), the inclusion of 0.5%w of HRGO increases the electrical conductivity more than three orders of magnitude. And what is more, the percolation limit of the conductivity in Z-axis is obtained with 0.25%w of loading. More than 0.1S/m is obtained through plane with 0.5%w of HRGO in the composite; while MWCNT need more than 1%w to obtain similar results. [2]

Applications of these structural composites can go between automotive [3] and aerospace industries; since the obtained values cover the electrical conductivity requirements, and provide structural parts able to act as antistatic or high electrical conductivity pieces in the body, according to the HRGO content. It is also important highlight the easy and appropriate features for the industrialisation of the method of preparation of these high electrical conductivity reinforced composites.

References

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