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HYBRID ELECTROSPUN TEXTILES OF CARBON MICROFIBRES AND TRANSITION METAL CARBIDES (MXENES) FOR ELECTROMAGNETIC INTERFERENCE SHIELDING

Abstract

Electromagnetic interference (EMI) caused by the growing number of radiation sources is an important topic involving malfunctioning of electronic devices and electromagnetic pollution with consequences for human activities on Earth and in Space. EMI shielding is, therefore, a requirement that involves a large variety of electronic devices and systems for which a wide range of shielding materials with different electrical conductivity, magnetic permeability and physical properties have been used to date. The field of the aerospace applications is particularly challenging from the point of view of the shielding materials because they have to efficiently reflect the radiated energy and, at the same time, they must be lightweight, flexible and mechanically resistant. In this work, hybrid textiles of carbon microfibres have been produced by the electrospinning of PAN (polyacrylonitrile) precursor solutions filled with different concentrations of Ti3C2Tx (MXenes) and evaluated in terms of EMI shielding characteristics in the frequency range of the X-band used for radar applications and satellite communications (8.0 – 12 GHz). The synthesis of carbon microfibres by electrospinning is a process that produces non-woven fabrics or coatings of conductive microfibres in a relatively simple way and with a controlled thickness that can be tailored from tenths to hundreds of microns. Carbon materials (nanotubes, graphene, fibres) are known to be conductive materials used for EMI shielding for their flexibility, superior corrosion resistance compared to metals and mechanical performances. MXenes are exfoliated transition metal carbides showing peculiar characteristics for their large surface area and unique electronic structure that determines high electrical conductivity. These materials are obtained by selective etching from metal carbide/nitrite (MAX phases) having layered hexagonal structure. The results demonstrated that the addition of MXenes in carbon microfibres significantly increased their EMI shielding properties in the frequency range of 8.0 - 12 GHz, even for thicknesses less than 100 microns. Measurements of the EMI shielding effectiveness (EMI-SE) showed values ¿ 60 dB. Compared to pure carbon microfibres the hybrid textiles produced maintained low density, high flexibility and easy processability. The mechanical properties typically observed in microfibres textiles were not compromise by the Ti3C2Tx addition. The EMI shielding effect observed in the hybrid carbon textiles together with the characteristic low density, high electrical conductivity,

intrinsic good mechanical properties, thermal stability and the possibility to be produced as free-standing fabric or coatings of metallic surfaces, make these materials an ideal candidate for aerospace applications.