Elektromagnetinės savybės anglies gelių

ELECTROMAGNETIC PROPERTIES OF CARBON GELS

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Carbon gels are produced by pyrolysis of thermoset polymer gels, which are themselves prepared by polycondensation of organic monomers diluted in a solvent. Once the crosslinking is achieved, the solvent can be removed by various processes, namely subcritical drying, supercritical drying or freeze-drying. These different routes lead to xerogels, aerogels and cryogels, respectively. Xerogels generally present the lowest porosity and the lowest surface areas, due to the action of capillary forces during solvent evaporation. This induces a significant shrinkage and hence a narrowing and even a collapse of the porosity. In contrast, aerogels are those in which the porosity is most preserved, precisely because of the absence of capillary forces during drying, leading to the highest pore volumes and the highest surface areas. Finally, cryogels have intermediate porosities and surface areas, because of the crystallisation of the solvent, which usually produces a porosity that is more preserved than that of xerogels but also coarser than that of aerogels. More information about synthesis, structure, properties and industrial applications can be found elsewhere [1].

The aim of present work is to investigate the electromagnetic properties of various carbon gels, produced with different bulk densities, were investigated in a wide frequency range (20 Hz–36 GHz). The values of dielectric permittivity and electrical conductivity at 129 Hz were found to be very high, i.e., more than 105 and close to 100 S/m, respectively. Both strongly decreased with frequency but remained high in the microwave frequency range (close to 10 and about 0.1 S/m, respectively, at 30 GHz). Moreover, the dielectric permittivity and the electrical conductivity strongly increased with the bulk density of the materials, according to power laws at low frequency. However, the maximum of microwave absorption was observed at lower densities. The DC conductivity (Fig. 1) slightly decreased on cooling, according to the Arrhenius law. The lower activation energies are typical of carbon gels presenting lower DC electrical conductivities, due to a higher number of defects. High and thermally stable electromagnetic properties of carbon gels, together with other unique properties of these materials, such as lightness and chemical inertness, open possibilities for producing new electromagnetic coatings.

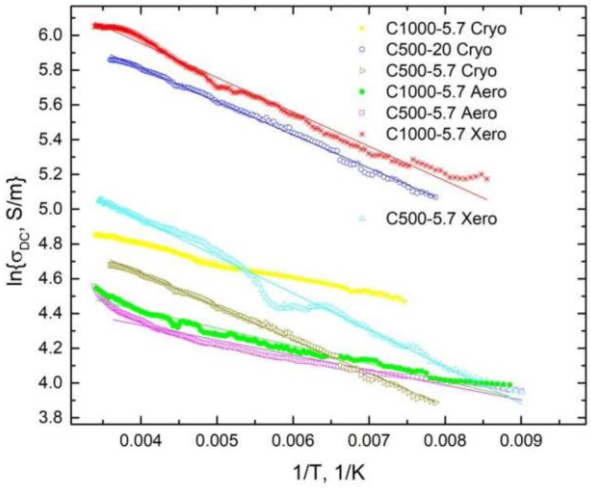

FIGURE 1. Temperature dependence of the DC conductivity of various carbon gels.

Keywords: dielectric, electromagnetic, carbon gels.

References

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