Mechanical and Electrical Properties of Polyacrylamide(PAAm)-Multiwalled Carbon nanotube(MWNT) Composite

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Polymer composites with carbon nanotube additions are one of the research subjects which have attracted a lot of attention in recent years. The first polymer nanocomposites using carbon nanotubes as filler were reported in 1994 by Ajayan et al. [1]. In recent years, carbon nanotubes have been used to improve the electrical and mechanical properties of polymers [2]. The mechanical and AC electrical properties of nanocomposites from doped multiwalled carbon nanotubes(MWNTs) with Polyacrylamide(PAAm) were measured.

Multiwalled carbon nanotube (MWNT) nanocomposites with Polyacrylamide (PAAm) were prepared via free radical crosslinking copolymerisation with different amounts of MWNTs varying in the range between 0.1 and 15 wt%. The mechanical properties of PAAm-MWNTs composite gels were characterized by the tensile testing machine. The alternative electrical conductivity (AC) of PAAm-MWNT composite gels was measured by the dielectric spectroscopy technique. A small content of doped nanotubes dramatically changed young modulus and conductivity, respectively.

Young modulus as a function of MWNT contents in Figure 1(a) increased progressively from 0.04 to 0.10 MPa, with the major increases occurring when the MWNT content was at or above about 0.6%. However, the dependence of young modulus on MWNTs content is more complex. At the lower concentrations(≤1vol%), the young modulus increases from the neat polymer value of 0.04MPa, only decreasing it when the MWNT content is above 3 vol%.

Figure 1(b) shows the effect of MWNT contents on conductivity of PAAm- MWNT composite gels at 5kHz. At a very low content of MWNTs (0.3%), the conductivity is quite low, however, after 0.3%, a definite increase in conductivity is observed. at contents between 0.3 and 1.0% MWNTs, some percentage of electrons are permitted to flow through the specimen due to the creation of an interconnecting conductive pathway. At contents above 1.0% MWNTs, the conductivities are stable by increasing the MWNT content.

In this work, we are able to test the properties of mechanical and conductivity of PAAm- MWNTs composite gels. In the tensile testing measurement, young modulus is found to be increased with the incorporation of MWNT into PAAm. If polymer systems which are initially of an isolator character are doped with carbon nanotubes of nano dimensions, composite gel systems with carbon nanotubes added become electrically conducting structures.

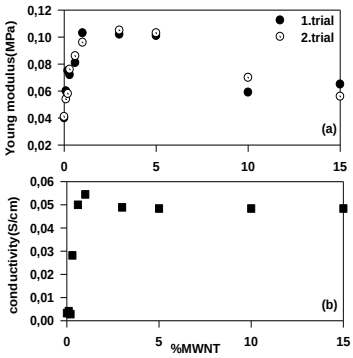

Fig. 1 (a)Young Modulus and (b)conductivity as a function of MWNTs

References

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