Electrical properties of Ni-silicone rubber piezoresistive composites under uniaxial pressure

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Abstract

The electrical characteristics of a Ni-silicone rubber composite that exhibits an extremely large piezoresistivity has been investigated. The ac conductivity and the relative permittivity have been measured as a function of frequency for a sample under selected uniaxial forces. The dc conductivity of the composite determined from the low frequency plateau of the ac conductivity is in excellent agreement with that obtained using a conventional dc technique. The dc conductivity is extremely sensitive to the applied uniaxial compression; it increases seven orders of magnitude with a uniaxial loading of 1kg. The dependence of conductivity on frequency has been discussed in terms of the predictions based on a model of microstructural networks. At high frequencies, both the ac conductivity and permittivity of the composite exhibit a power law dependence on frequency, which is consistent with the prediction of the microstructural networks model. The permittivity of the composite sample increases with uniaxial force, suggesting that the composite may be used to develop pressure tunable capacitors. A remarkable skin effect is observed in the frequency dependence of conductivity of the sample under uniaxial forces above 500 gram, which may have important ramifications in the design of radio-frequency and microwave applications and to some extent in ac electrical power transmission and distribution systems.

References

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