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Electrical and thermal conductivity of hybrid nanocomposites with giant strain KYOUNG-YONG CHUN, SHI HYEONG KIM, MIN KYOON SHIN, Hanyang University, Korea, GEOFFREY M. SPINKS, University of Wollongong, ALI E. ALIEV, RAY H. BAUGHMAN, University of Texas at Dallas, SEON JEONG KIM, Hanyang University, Korea, KYOUNG-YONG CHUN, SHI HYEONG KIM, MIN KYOON SHIN, SEON JEONG KIM TEAM, GEOFFREY M. SPINKS COLLABORATION, ALI E. ALIEV, RAY H. BAUGHMAN COLLABORATION — The prospect of electronic circuits that are stretchable and bendable promises tantalizing applications such as skin-like electronics, conformable sensors, and lightweight solar cells. The optimization of electronic, thermal, and mechanical properties of conductive and extensible materials is necessary for the application of energy device. Here we demonstrate the theoretical prediction for the electrical conductivity of the nanocomposites compared with experimental results. Also, we present the giant dependence of electrical conductivity on strain and the large positive thermal expansion that can be expected for the elastomer matrix. The percolation threshold (26 vol% of Ag, average interparticle distance model) and Poisson's ratio (Vt=0.33, Vw=0.2) of nanocomposites are significant factors that can determine the electrical and thermal conductivity with giant strain. The thermal conductivity for the electronically conducting elastomeric film is relatively high at the zero-strain state, and shows a non-metallic temperature dependence consistent with phonon transport. The observed combinational property of a very small dependence of conductivity on temperature with an exponential dependence can be suitable for for the mechanical strain sensing.

Kyoung-Yong Chun
Center for Bio-Artificial Muscle and Dept of Biomedical Engineering,
Hanyang University, Seoul, 133-791, Korea

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