School of Nano Science

School of PHYSICS

IPM Condensed Matter & Statistical Physics Group

Weekly Seminar

An Experimental Study on Piezoresistive and Piezoelectric Characteristics of Nano‐fillers Embedded Polyurethane (PU) Composites as self-powered sensors

Invited Speaker:

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Abstract:

The present study assesses the applicability of carbon materials embedded polyurethane (PU) composites characterized by high piezoresistive capability, as a traffic-loading sensor. PU composites incorporating multi-walled carbon nanotubes (MWCNTs), expanded graphite (EG), and a hybrid of MWCNTs and graphite nanoplatelets (GNPs) were fabricated and their electrical conductivities were measured in an effort to determine the most suitable filler type for the piezoresistive sensor and its optimum content ratio. The best electrical characteristics were achieved by the MWCNT/PU composites as exhibiting the percolation threshold at 5 wt.% of MWCNTs and the maximum electrical conductivity of 0.33 S/m at 7 wt.%. Accordingly, the MWCNT/PU composites were prepared as a piezoresistive sensor, and its sensing capabilities and durability were examined by lab-scale loading, vehicular loading, and cyclic wheel loading tests. The composite with 5 wt.% of MWCNT showed the best sensing capability in terms of the electrical resistance change rate obtained from the lab-scale and vehicular loading tests. In addition, the cyclic wheel-loading test demonstrated that the 5 wt.% MWCNT embedded PU composite was durable during 2000 cycles of the wheel loading.

A zinc oxide (ZnO)/PU-based generator composite was also fabricated and its piezoelectric performances were examined. In addition, the influence of MWCNTs and copper powder incorporation on the piezoelectric performance of composites was studied. The performance level of the composites with various ratios of the constituents was compared in terms of piezoelectric responses obtained from foot stamping, vehicle-loading, and cyclic wheel loading tests. The foot stamping and vehicle loading tests revealed that the generator composite solely embedded with ZnO nano materials exhibited the best performance among the others, while the influence of MWCNT and copper powder addition on the performance was minor. The cyclic wheel-loading test (durability test) demonstrated that the generator composite sustained 2000 cycles of 400 kg-weighed wheel loading and a prominent output voltage peak produced was as high as 40.45 V.

Wednesday, 20 Mordad 95 (10 August, 2016), 2-3 pm

Farmaniyeh seminar room