COINAPO

COMPOSITE MATERIALS OF INORGANIC NANOTUBES AND POLYMERS

1st COINAPO Topical Meeting

Polymer composites with inorganic tubular nanomaterials Fabrication, Properties and Technical Applications

25th - 26th of October 2010

in

Zaragoza, Spain

cost

ita

INSTITUTO TECNOLOGICO DE ARAGON

COINAPO
COMPOSITE MATERIALS OF INORGANIC NANOTUBES AND POLYMERS

Polyisoprene composites with conductive tubular nanostructures for multifunctional sensing: fabrication and properties

M.Knite[1], I.Aulika[2], A. Mrzel[3] A.Fuith[4], M. J. Zavickis[1], G.Sakale[1], A.Linarts[1], M.Dunce[5]

[1] *Institute of Technical Physics, Riga Technical University, Riga, Azenes str.14, Latvia*

[2] *Center for Space Human Robotics, Italian Institute of Technology, Corso Trento 21, 10129 Turin, Italy*

[3] *Jožef Stefan Institute, Jamova 39, Ljubljana, Slovenia*

[4] *Faculty of Physics, University of Vienna, Boltzmanngasse 5, A-1090 Wien, Austria*

[5] *Institute of Solid State Physics, University of Latvia, Kengaraga str.8, Latvia*

Recent achievements of scientific group of Riga Technical University in collaboration with COINAPO partners in design, processing and investigation of polyisoprene composites with conductive tubular nanostructures (PCCTN) as prospective materials for completely hyper-elastic (non-rigid) mechanical (pressure, strain) indicators, chemical vapour indicators as well as temperature indicators have been presented. Non-rigid multifunctional sensing materials attract attention of scientists and engineers because of potential possibility to incorporate them in different solid and nonsolid systems for specific parameter control.

Previous experience with electro-active materials like ferroelectrics suggests that maximum sensitivity of material to any influence is observed in the vicinity of phase transitions. The percolation transition in PCCTN could be imagined as specific phase transition from electrically insulating state to electrically conductive state. Thus, the maximum sensitivity of PCCTN materials to external thermodynamic forces (ETF) should be expected in the vicinity of percolation threshold. The reversibility of material reaction to ETF should be achieved by positioning conductive tubular nanostructures in the spatial grid by curing of hyper-elastic polymer matrix.

Our previous research approved that high structure carbon black PRINTEX XE2 filled composites demonstrate finger pressure sensitive piezoresistivity as well as good organic solvent vapour sensing. Conductive tubular nanostructures originate with variable length to width ratio and high electric conductivity in longitudinal direction of the tubes, which theoretically should make it possible to obtain electric percolation in polymer-carbon nanotube composites at very low loads of filler. However recent experience with mechanically dispersed carbon nanotubes shows quite high values of percolation threshold and specific sensing properties.

In this work we present an attempt to use ultrasound for improved dispersion of the filler in polyisoprene matrix composite. Multi wall carbon nanotubes (MWCNT) "Aldrich 636835" as well as inorganic nanotubules (IN) $Mo_6S_2I_8$ and MoO_{3-X} are used as filler. As reference filler PRINTEX XE2 was also used.

The noticeable shifting of percolation threshold to lower values of concentration has been achieved for all types of nano-composites. The piezoresistive and chemosensitive behaviour of sonicated nano-composites have been determined and compared with mechanically mixed ones. The obtained results are explained using quantum mechanical charge tunnelling and percolation theory.

cost

ita
INSTITUTO TECNOLOGICO DE ARAGON