Mechanical and Dielectric Properties versus Structure: Study of epoxy resin /barium titanate nanocomposites

I.A. Asimakopoulos[1*], G.C. Psarras[2] and L. Zoumpoulakis[1]

[1]*National Technical University of Athens, School of Chemical Engineering, Departement III "Materials Science and Engineering", Laboratory Unit "Advanced and Composite Materials", 9-Heroon Polytechniou street, Zografou Campus, Athens 157 73, Greece*
[2]*Department of Materials Science, School of Natural Sciences, University of Patras, Patras 26504, Greece*

The development of microelectronic devices targets on reducing both their dimensions and weight. New high dielectric constant and low loss materials are needed to replace the current wire insulators of silicon dioxide, thereby reducing the signal delays and electrical power loss in the new generations of large scale integrated circuits [1–4]. Nanoinclusions can be considered as a distributed network of nanocapacitors, which can be charged and discharged defining an energy storing process, at the nanoscale level [5-8]. Epoxy resins are presently important organic matrices in composite industry. They are frequently used in demanding applications due to their excellent mechanical properties, thermal stability and chemical resistance. Furthermore, they also have good resistance to moisture, solvents and chemical attacks [9- 11]. Inorganic additives, such as silica and alumina have been used to increase the toughness of epoxies without sacrificing their basic properties, but the presence of numerous inorganic particles increase the viscosity leading to poor dispersion and processing difficulty [11–14]. The aim of this study is the investigation of composites combining epoxy resin with embedded nano-barium titanate particles studied as far as their structure (SEM, DSC, FTIR, XRD etc.) and their mechanical (shear strength) and dielectric properties are concerned.

References

[1] Homma T., Materials Science and Engineering R: Reports **23**, 243–285 (1998).
[2] Geng Z., Lu Y., Zhang S., Jiang X., Huo P., Luan J.,Wang G., Polymer International, (in press).
[3] Cho E-B., Mandal M., Jaroniec M., Chemistry of Materials, **23**, 1971–1976 (2011).
[4] Wang C., Wang T. M., Wang Q. H., Express Polymer Letters, **7**, 667-672 (2013).
[5] Psarras G. C., Express Polymer Letters, **2**, 460 (2008).
[6] Tantis I., Psarras G. C., Tasis D., Express Polymer Letters, **6**, 283–292 (2012).
[7] Asimakopoulos I., Zoumpoulakis L., Psarras G. C., Journal of Applied Polymer Science, **125**, 3737-3744 (2012).
[8] Asimakopoulos I.A., Psarras G. C., Zoumpoulakis L., Express Polymer Letters (in press).
[9] Kim J., Yim B-S., Kim J-M., Kim J., Microelectronics Reliability, **52**, 595–602 (2012).
[10] Jiao J., Sun X., Pinnavaia T. J., Polymer, **50**, 983–989 (2009).
[11] Qi B., Lu S. R., Xiao X. E., Pan L. L., Tan F. Z., Yu J. H., Express Polymer Letters, **8**, 467-479 (2014).
[12] Tang L.C., Zhang H., Sprenger S., Ye L., Zhang Z., Composites Science and Technology, **72**, 558–565 (2012).
[13] Lu S-R., Jiang Y-M., Wei C., Journal of Materials Science, **44**, 4047–4055 (2009).
[14] Johnsen B. B., Kinloch A. J., Mohammed R. D., Taylor A. C., Sprenger S., Polymer, **48**, 530–541 (2007).