NANOSTRUCTURED THERMOSETTING SYSTEMS DESIGNED USING BLOCK COPOLYMERS AS TEMPLATE FOR THERMO-, PHOTO- AND ELECTRO-RESPONSIVE MATERIALS

Agnieszka Tercjak, Junkal Gutierrez, Daniel H. Builes, Laida Cano, Raquel Fernández, Iñaki Mondragon

Group `Materials + Technology´, Polytechnic School, University of the Basque Country, Plaza Europa 1, 20018 Donostia-San Sebastián
(agnieszka.tercjaks@ehu.es, www.ehu.es/GMT/index.php)

In this work different block copolymers (BCP) were used as templates for generating nanostructured epoxy or unsaturated polyester matrices with long range order structure. Both amphiphilic [1-4] and epoxydized BCP [5] consisting of thermoset-miscible and thermoset-immiscible blocks were used to obtain nanostructured thermosetting systems, which act as template for designed thermo-, photo- or electro-responsive materials. Low molecular weight liquid crystals [1, 6-8], azobenzenes [4] and TiO_2 nanoparticles [1-3] were used as ternary component in order to develop novel nanostructured materials, which can respond to the external stimuli such as temperature, electrical field or laser beam.

The relation between morphology generated and thermo and electro-responsive properties of designed systems was investigated using atomic force microscopy (AFM). AFM images were obtained operating in tapping mode (Nanoscope IIIa scanning probe microscope (MultimodeTM, Digital Instruments) and Nanoscope IV (Dimension 3100, Digital Instruments)). The ability of alignment of low molecular liquid crystals and electrical properties of TiO_2 nanoparticles were studied by electrostatic force microscopy (EFM) (Nanoscope IV (Dimension 3100, Digital Instruments)) and tunneling atomic force microscopy (TUNA) (Nanoscope IV (Dimension 3100, Digital Instruments)). Additionally, electrical response of the nanocomposites was measured using a semiconductor characterization system (Keithley model 4200-SCS).

As show in the Figure 1 designed nanostructured thermosetting materials maintain properties of ternary components such as liquid crystals (LC), nanoparticles or azobenzenes that makes them interesting from the point of

view of potential application in the field of thermo- and electro-optical devices, such as optical shutters, smart windows, optical sensors, memories and flexible display devices .

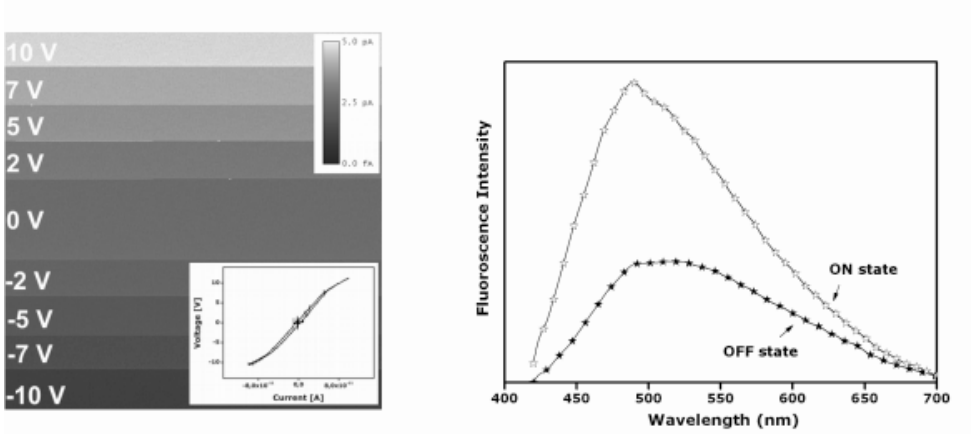

Figure 1. TUNA current map of the 1 wt % TiO_2/40 wt % LC-(DGEBA/MXDA) system obtained by applying different voltages. Fluorescence emission spectra of this system taken at 10 and 45 ºC

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References

1. Tercjak A., Gutierrez J., Peponi L., Rueda L., Mondragon I., Macromolecules 42:3386-3390, 2009.
2. Gutierrez J., Tercjak A., Mondragon I., Journal of Physical Chemistry C 114:22424, 2010.
3. Gutierrez J., Mondragon I., Tercjak A., Polymer 52:5699-5707, 2011.
4. Builes D., Tercjak A., Mondragon I., Polymer in press, 2012
5. Fernández R., Ramos J.A., Espósito L., Tercjak A., Mondragon I., Macromolecules 44:9738-9746, 2011.
6. Tercjak A., Mondragon I., Langmuir 24:11216-11224, 2008.
7. Tercjak A., Gutierrez J., Ocando C., Mondragon I., Langmuir26:4296-4302, 2010.
8. Tercjak A., Mondragon I., Polymer dispersed liquid crystal, thermotropic and other responsive epoxy polymers. In: Pascault J.P., Williams R.J.J. Mann S., editors. Epoxy polymers. New materials and innovations. Weinheim (Gemany): Wiley-VCH, 2010. p. 121-136.