

Study of Thermal Properties of Liquid Crystal/Polymer Composites Under Electrical Field by PPE Calorimetry

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Polymer/liquid crystal composites appeared at the end of the 1980's as a new kind of material. Under certain circumstances, a phase separation occurs and leads to formation of microsized droplets of low molecular mass liquid crystal dispersed in an isotropic polymer matrix. They are then called PDLC (polymer dispersed liquid crystal) (1). These materials are interesting from a fundamental point of view, but also due to their various applications, such as flexible display and switchable windows. Indeed, PDLC films can be switched electrically from a light scattering off-state to a highly transparent on-state. Numerous studies have been carried out on these systems for optimizing the phase separation process in order to control the final electro-optical properties of the films, but studies on their thermal properties are seldom found. These materials are also interesting for the study of thermal transport phenomena in heterogeneous materials. Such a study requires the determination of the contribution of the dispersed inclusion in host matrix to the global effective thermal properties of the system. In a PDLC film the thermal properties of the inclusions (the droplets) can be modified upon application of an electric field without a modification of the general structure of the system (number, size and distribution of the inclusions). Due to their dielectric anisotropy, the LC molecules will tend to align their long axis with the applied electric field, resulting in a change of their thermal conductivity contribution along the heat propagation direction. Using an adapted configuration of the PPE cell (2), allowing the application of an electric field to the sample during the measurement, we have measured the thermal properties (thermal diffusivity and effusivity) of a PDLC for different applied voltages. The evolution of the effective thermal parameters as a function of the electric field for different morphology (droplets sizes and distribution) has been analysed using a model based on the effective medium theory and taking into account interfacial resistance. From this analysis, the behaviour of the liquid crystal confined in the droplets has been extracted, and effect of anchoring force and elastic properties of the mesophase has been evaluated.

[1] P. S. Drzaic, *Liquid Crystal Dispersions*, World Scientific, Singapore 1995.

[2] S. Delenclos, M. Chirtoc, A. Hadj Sahraoui, C. Kolinsky, J.M. Buisine, *Rev. Sci. Instrum.* 73 (7) (2002), 2773