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Electrically induced polymerization process

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Abstract

This talk strives to show the electropolymerization discovered in our laboratory in 2011 (EP2674806; US9664930; WO2012103663). Unlike electrochemical polymerization, it occurs in molten monomers without solvent, electrolytes nor initiators added. We have found that this process propagates radically and can be stopped and resumed on demand by removing and reapplying the electric field. While we found that the polymerization propagates as a radical chain polymerization, we did not find how the polymerization initiates.

This process was originated from studies in polar systems consisting in a mixture of a liquid-crystalline polymer (LCP) PM6R8 with its respective monomer M6R8 (US5833833; AT193158; CA2193563; CA2193563; DE19547934; EP0780914; JPH09237921). Since 1974 (Meyer, R. B., J. Phys. Letters 36, 69–71 (1975)), it has been known that for a LC system to be polar, a tilted phase and at least one chiral center are required. However, Soto-Bustamante et.al demonstrated that achiral polymer/monomers mixtures are antiferroelectric just by the interaction between two achiral components (Soto-Bustamante et al, Chem. Phys. Lett. 260, 447–452 (1996)), by measuring the pyroelectric signal, which is an intrinsic property of a ferroelectric material.

When studying these systems, the first hint that polymerization took place was through the pyroelectric study of monomer M6R8. We repeat the same procedure applied to the composites: beginning from 180°C and cooling at 4°C/min to RT while a field is applied. A pyroelectric signal appears at high temperature while cooling before the monomer reaches the mesophase. With the 4°C/min cooling rate the field was applied in the isotropic state at least 30 minutes. It was corroborated later that polymer formation was induced by the applied field.

This work focused both on the characterization of the obtained polymers from our electrically induced polymerization method and the characterization of the polymerization method itself, focusing on the mechanism of the polymerization.

Biography

Eduardo Soto-Bustamante has completed his PhD at the age of 33 years from Darmstadt University of Technology, Germany. He is the director of Innovation and Technology Transfer of the Faculty of Chemical and Pharmaceutical Sciences and President of the Central Commission of Industrial Property at the University of Chile, Chile. It's research interest relates to Low and High Molecular Weight Liquid Crystalline Systems with (Anti) ferroelectric Properties, Nanomaterials and in recent times also Biopolymer Characterization. Leading several projects with Universities (Fulbright; Volkswagen Stiftung), Industry (Merck; BeamCo; Anton Paar) and foreign institutions (WUS; TWAS; DFG) in this thematic topic, allowing him to publish more than 60 peer reviewed publications, two international patents, books, and book chapters. He has over 60 publications which have been cited over 600 times, and his publication H-index is 14.

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