ORIENTATED CRYSTALLIZATION IN DISCONTINUOUS ARAMID FIBER/ISOTACTIC POLYPROPYLENE COMPOSITES UNDER SHEAR FLOW CONDITIONS

Boris Larin*, Carlos A. Avila-Orta,***, Rajesh H. Somani***, Benjamin S. Hsiao*** and Gad Marom***

[Boris Larin]: boriska@pob.huji.ac.il

* Casali Institute of Applied Chemistry, The Institute of Chemistry, The Hebrew University of Jerusalem, 91904 Jerusalem, Israel,

** Departamento de Química de Polímeros, Centro de Investigación en Química Aplicada Saltillo, Coahuila C.P. 25100, México

*** Department of Chemistry, State University of New York at Stony Brook, Stony Brook, NY 11794-3400, USA

Keywords: Shear flow induced crystallization, aramid fiber, iPP blends, shish-kebab morphology

The crystallization behavior of thermoplastic polymers is strongly affected by processing conditions. The subject of flow-induced crystallization in polymer melts is extremely important in polymer processing. This is because the final properties of polymers are the direct consequence of the crystalline morphology, where the final morphology is often dictated by the early structure formation under flow. Furthermore, flow is known to significantly enhance the kinetics of crystallization and to produce highly oriented morphologies.

The aim of the research is to study the types of oriented crystalline morphology and the kinetics of crystallization in polymer blends as a function of the processing conditions and the polymer properties. The current study, which follows our recent works on iPP/PE blends attempts to assess the combined nucleating effect of the two simultaneous components, namely of the aligned 'shish' molecules and of the orientated fibers, in the short fiber containing melt under shear flow conditions. Melt-mixed polymer blends were composed of isotactic polypropylene (iPP) and 3 mm long chopped aramid fibers (Kevlar 49). The structural evolution was examined by *in-situ* synchrotron X-ray scattering/diffraction at the National Synchrotron Light Source (NSLS), Brookhaven National Laboratory (BNL), USA. A method was used to deconvolute the total integrated scattered intensity into contributions arising from the isotropic and anisotropic components of the crystallized chains. The fraction of oriented crystallites was determined from the ratio of the scattered intensity due to the oriented (anisotropic) component to the total scattered intensity. The final morphology was evaluated by X-ray microbeam at European Synchrotron Radiation Facility (ESRF), France and by both high resolution scanning electron microscopy and differential scanning calorimetry. The results show that shear flow in iPP accelerates the crystallization kinetics and induces orientated crystallinity of both the α and β forms, and that these phenomena are amplified by the presence of discontinuous fibers, leading to faster crystallization kinetics and to transcrystalline growth perpendicularly to the fiber. When the fiber orientation is affected by shear flow, a combined effect of flow and surface nucleation prevails. The question that our current research addresses is whether the resultant effect of flow and fiber surface induced nucleation comprises synergistic or additive interaction.