Type of presentation: Poster

MS-6-P-2411 Influence of selected substrates and nanoparticles on crystallization of isotactic polypropylene

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Nucleated polymer crystallization is used to fine-tune the morphology and properties of semicrystalline polymers, such as polyethylene and polypropylene. The polymer crystallization rate is increased by numerous substances (nucleating agents), but also the substrate influences the crystallization process. The nucleation facilitates the formation of crystal nuclei, which results in higher concentration of nucleation centers and smaller average size of spherulitic crystals [1].

We investigated crystallization of isotactic polypropylene (PP; Mosten GB005) on three different surfaces: microscopic cover glass, atomically flat mica, and highly oriented pyrolitic graphite (HOPG). Moreover, mica and HOPG surfaces were covered with: (i) vacuum-sputtered gold nanoparticles, whose morphology and size were controlled by a combination of sputtering time and thermal treatment [2], (ii) commercial TiO2 nanoparticles (size ~ 200nm, Sigma-Aldrich), titanate nanotubes (TiNT) [3], and commercial alpha-nucleating agent (Hyperform HPN-68).

PP film (350 um) was placed on one of the above-described substrates, molten at 200 C and isothermally crystallized at 120 C. The concentration of nucleation centers was determined by microscopic methods: The PP films were removed from the substrates, etched with permanganic mixture [4], sputtered with platinum and observed by FEGSEM.The micro- and nanostructure of PP contact surface after its detachment from the support was studied also by light microscopy (LM) and atomic force microscopy (AFM).

FEGSEM micrographs (Fig. 1) of PP surfaces crystalized on clean substrates showed that PP crystallization is affected only by HOPG, while glass and mica did not influence the size of spherulites. The impact of Au nanoparticles (Fig. 2a–d) deposited on mica on PP crystallization was very weak (Fig. 2e–h), which was in agreement with our previous work [1]. Small Au nanoparticles deposited on HOPG also did not have any nucleating effect on PP crystallization. In contrary, they acted as obstacles for crystallization of PP on the nucleating surface of HOPG.

References:

[1] Pavlova E et al.: J. Polym. Sci., Part B: Polym. Phys. 49 (2010) 2504.

[2] Tracz et al.: Eur. Polym. J. 41 (2005) 501.

[3] Kralova et al.: Mater. Chem. Phys. 124 (2010) 652.

[4] Slouf et al.: J. Biomed. Mater. Res. B Appl. Biomater. 85 (2008) 240.

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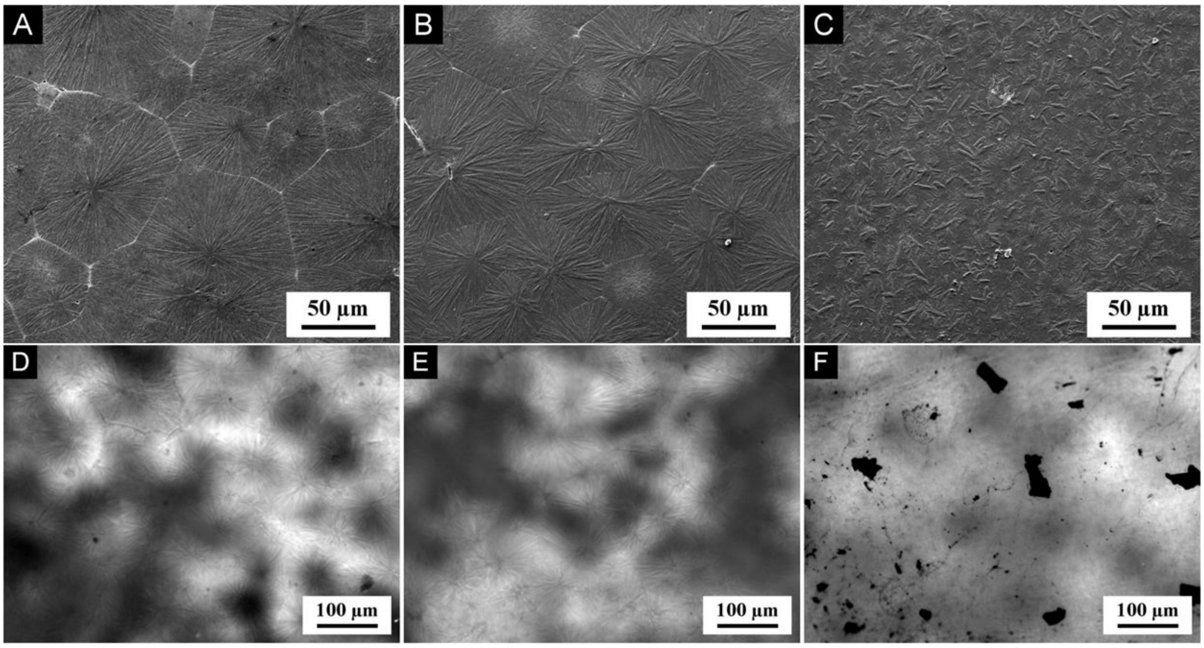

Fig. 1: Fig. 1: SEM and LM micrographs of the PP contact surface crystallized on: (A and D) cover glass; (B and E) mica; (C and F) HOPG.

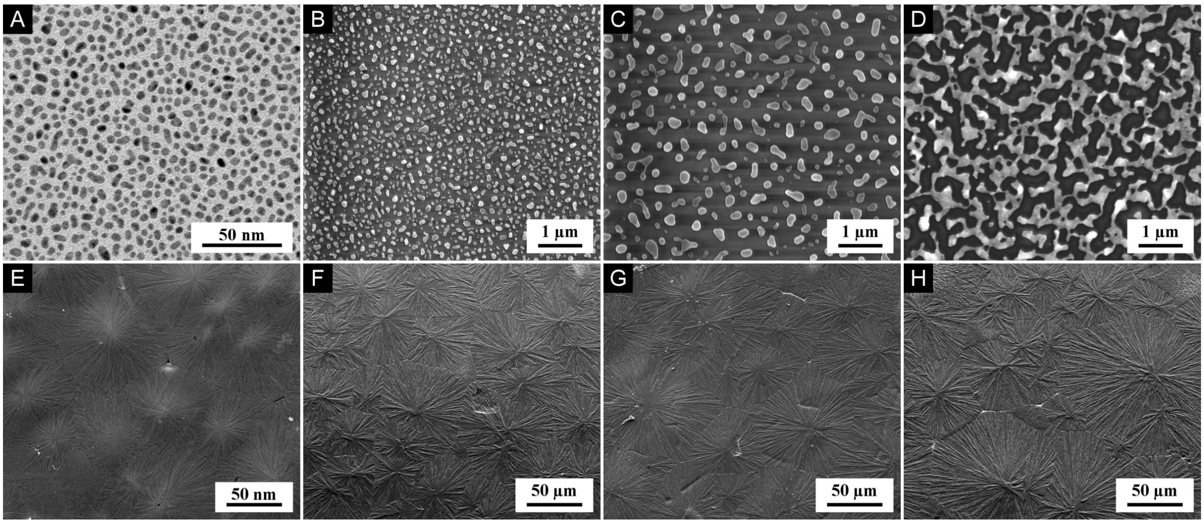

Fig. 2: Fig. 2: Morphology of Au nanoparticles with different size, deposited on mica: (A) Au~5nm; (B) Au~100nm, (C) Au~300nm, and (D) Au islands. Lower row (E-H) shows the FEGSEM micrographs of the PP crystallized on the substrates above.