

Characterization of morphology, crystallization and melting behaviour of films of ethylene-vinyl acetate (EVA) by means of AFM and DSC

J. Diaz¹, E. Xuriguera², S. González-Martín²

¹ Nanometric Techniques Unit. Scientific-Technical Services. University of Barcelona. C/ Lluís Solé i Sabarís 1-3. 08028 Barcelona

²Diopma, IN2UB, Departament de Ciència dels Materials i Enginyeria Metal·lúrgica, Universitat de Barcelona, Martí i Franquès 1, E-08028 Barcelona, Spain
jdiaz@sct.ub.es

The crystallization, the morphology and the thermal behaviour of films of ethylene-vinyl acetate copolymer (EVA) were investigated by means of Atomic Force Microscopy (AFM) and differential scanning calorimetry (DSC). Real-time AFM phase imaging enables us to observe the crystallization process of EVA24.

The EVA used was polydispersed random copolymer with 24 wt% nominal of vinyl acetate (EVA24).

The strategy to characterize the behaviour of EVA24 was an isothermal crystallization, a time-to-event experiment. A typical method consists of raising the sample above its melt temperature and holding isothermally for a couple of minutes to ensure that it was completely melted. The sample was then rapidly cooled and stabilized at the desired test temperature [1-2].

The dynamic crystallization process of EVA24 was directly observed using tapping-mode AFM (TM-AFM). For this purpose, a heater was coupled to the AFM to realize the isothermal crystallization of EVA24.

The isothermal crystallization temperature (T_c) used for in-situ observations with AFM was previously optimized with DSC. The study with DSC reproduces the same conditions, i.e., EVA24 film was melted and next cooled at the desired temperature. The melting and crystallization temperatures were verified through a standard DSC with a typical temperature-scanning rate of 10°C/min. These are 64°C for T_m and 51°C T_c . Isothermal DSC at different temperatures in the vicinity of T_c were performed in order to choose the appropriate T_c , which brings enough time to observe the crystallization process in AFM. The selected temperature was 61°C.

During crystallization ethylene-vinyl acetate (EVA) is ejected on the surface of the film forming droplet-like domains. A different morphology is observed. AFM images recorded at different temperatures demonstrated height changes of different domains caused by crystallization of ethylene-vinyl acetate [3].

References

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