A microdiffraction study on the confinement effects in one-dimensional polymer arrays

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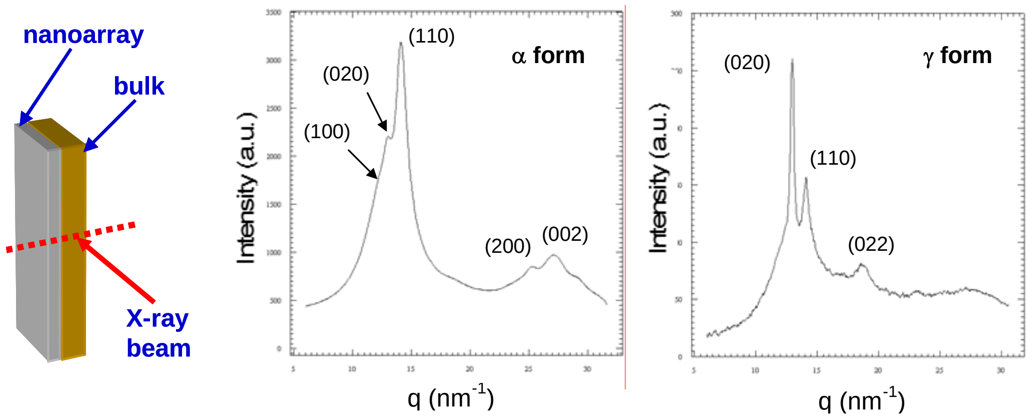
Polymer arrays of nanorods or nanotubes exhibit interesting behavior for applications in photonics, electronics, mechanical, and biomedical devices.[1] Moreover, they are appropriate for studying size-dependent processes with length scales comparable to some of the sizes of the nanostructure, such as phase separation in block copolymers, or crystalline textures[2].

Wetting of porous anodic aluminum oxide (AAO) templates has been used for the preparation of 1D polymer nanostructures. This technique is based on the fact that polymer melts and solutions tend to wet the walls of nanoporous templates avidly if the walls exhibit a high surface energy.[3] The properties of partially crystalline polymer nanostructures will depend largely on the properties of their crystalline domains.

This contribution will cover recent research on these phenomena for the particular case of poly(vinylidene difluoride) (PVDF) 1D nanostructures. We selected this polymer owing to the piezoelectric properties of some of its crystal modifications[4] and the considerable potential of PVDF nanoarrays for applications in the field of organic electronics.[1] X-ray microdiffraction (μ-XRD) using synchrotron radiation has been performed at ID13 beamline (ESRF). Scanning the sample with 1 μm diameter X-ray beam, from the residual PVDF film (bulk) to the nanorod array, we have investigated the spatial evolution of degree of crystallinity, crystal orientation and what is even more interesting the solid-solid phase transition from the α non polar crystal form (bulk) to the γ polar ferroelectric form (nanostructure array).



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