Investigations of a Semi-Crystalline Fluorinated Terpolymer of Tetrafluoroethylene (TFE), Hexafluoropropylene (HFP), Vinlyidene fluoride (VDF) Confined to Ordered Nanoporous Alumina

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Understanding the properties of confined polymers at solid inter-phases in nanocomposites is still challenging. Ordered anodic aluminum oxide (AAO) membranes [1] with aligned cylindrical nanopores having pore diameters from 20 to 400 nm and sharp pore diameter distributions are ideal inorganic model components for studying polymeric inter-phases in nanocomposites. We have investigated a fluorinated terpolymer synthesized by copolymerizing tetrafluoroethylene (TFE) with hexafluoropropylene (HFP) and vinylidene fluoride (VDF), namely THV (provided by Dyneon), inside the cylindrical nanopores of AAO. Due to low processing temperatures, high flexibility and excellent transparence, THV has been used in different areas such as solar cells and optical fiber applications [2, 3].

We applied several techniques such as solid-state NMR, TEM (Figure) and wide-angle X-ray (WAXS) in investigating both microstructures and physical properties of THV at solid inter-phases. NMR has been employed for studying the sequence order of THV in bulk, TEM for analyzing morphology and X-ray scattering for investigating crystallinity of the one-dimensional THV nanostructures.

The quantification from the NMR spectra indicated that THV is a mostly random terpolymer with a limited fraction of alternating TFE-HFP and TFE-TFE sequences. THV forms solid nanorods in the nanopores of AAO when infiltrated as melt. In the case of THV inside porous alumina with pore diameters of 60 nm and 20 nm, reflections in the WAXS profiles obtained from oriented THV-500 G nanorods inside AAO revealed the presence of order.

Figure. TEM image of released THV-500 G nanorod.

REFERENCES