Surface Properties and Higher Ordered Structures in Perfluorinated Polymers: Layered Structure of Perfluoroalkyl Group and Periodic Lamellar Structure in the Block Copolymer

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Perfluoroalkyl ($R_f$) groups are well known for their excellent surface properties, such as hydrophobicity and anti-fouling behavior. The surface properties are enhanced discontinuously when the carbon number ($n$) of $R_f$ chain becomes larger than 8. Among variable perfluoroalkyl compound, comb-shaped polymers with $R_f$ side-chain are prospective materials because of the high processability by solution coating method. In particular, the comb-shaped polymers with the same poly(acrylate) backbone and short $R_f$ side-chain with fewer than 7 carbon atoms are amorphous, while those with larger than 8 carbon atoms formed highl-ordered smectic structure. It means the surface properties are dominated not only the low surface-free-energy (chemical property) of the $R_f$ groups but also the higher ordered structures [1]. Therefore, it is important to understand the ordered structure of $R_f$ side-chains in the comb-shaped polymer for controlling the surface properties.

In this presentation, typical comb-shaped perfluorinated polymer, poly{2-(perfluorooctyl ethyl) acrylate} (PFA-C$_8$), is focused on and the higher ordered structures of PFA-C$_8$ in the homopolymer and the block copolymer with a main-chain liquid crystalline polyester (MCLCP) [2], both in the bulk and thin film state, will be discussed based on synchrotron (SR) X-ray scattering methods. SR X-ray analyses revealed that smectic layer of $R_f$ groups epitaxially grew at the surface (air-interface). In the case of the block copolymer, complex morphologies (lamellar nano-structure) were observed in the thin film due to the orientation frustration between PFA-C$_8$ and MCLCP. The details will be discussed in the presentation.

References