Smectic Liquid Crystalline Structure and Thermal Stability of Perfluoroalkyl Side-Chain Polymers

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Abstract

Perfluorooctyl (R_f) groups are well known for their excellent surface properties, such as hydrophobicity and anti-fouling behavior. Particularly, when the carbon number (n) of the R_f chain reaches 8, the surface properties remarkably enhanced because of an ordered layer structure, *i.e.* smectic liquid crystalline (LC) structure of R_f side-chains [1]. In the layered structure, trifluoromethyl group, which is the end group of the R_f and has very low surface free energy, aggregates the surface to decrease the surface free energy. Among variable fluorinated polymer, a series of comb-shaped polymers with R_f side-chain is prospective materials because they can be easily coated from the solution. Stability of surface properties and also the thermal stability of the smectic LC structure are essential for the application. In this work, the relationship between thermal stability and the ordered structure was investigated for two analogous comb-shaped polymers bearing perfluorooctyl ethyl (-$CH_2CH_2(CF_2)_7CF_3$) side-chain: one is a poly(acrylate) (PFA-C_8) and another is a poly(vinyl ether) (PFAVE8), inset in figure 1. Phase transition behaviors (melting temperature) were investigated by differential scanning calorimetry (DSC, presented in figure 1). The thermal stability of these polymers was discussed based on the structure analyzed by synchrotron X-ray diffraction methods, and Fourier transform infrared spectroscopy (FTIR) measurements.

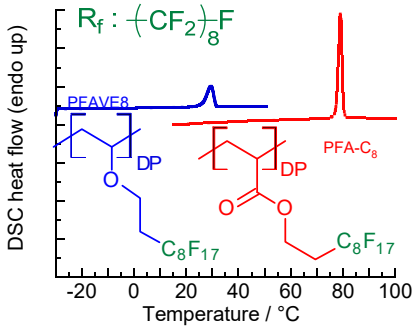

Fig. 1 DSC thermograms of PFA-C_8 and PFAVE8 during second heating processes and these chemical structures.

REFERENCES

[1] Ishige *et al*. *Macromolecules*, 47, 12, 3860−3870 (2014).