Investigation of Equilibrium Melting of Polyfluorenes by Kratky-Porod Approximation

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The crystalline PFO and PFH specimens were prepared in terms of a serial annealing temperature which below their melting temperature. Using the NSRRC-17B3 W20 beam line, the simultaneous differential scanning calorimetric small- angle and wide-angle X-ray scattering (SAXS/WAXS) are measured. The energy of light is 5 keV with wavelength 1.54979 Å. The specimens were heating up to the initial examined temperature (i.e. pre-annealed temperature) at first, and then start to collect the SAXS/WAXS/DSC data during the programming heating (1.5 ^{o}C/min) process. Both small-and wide- angle scattering and DSC results are recorded until the melting point to attain.

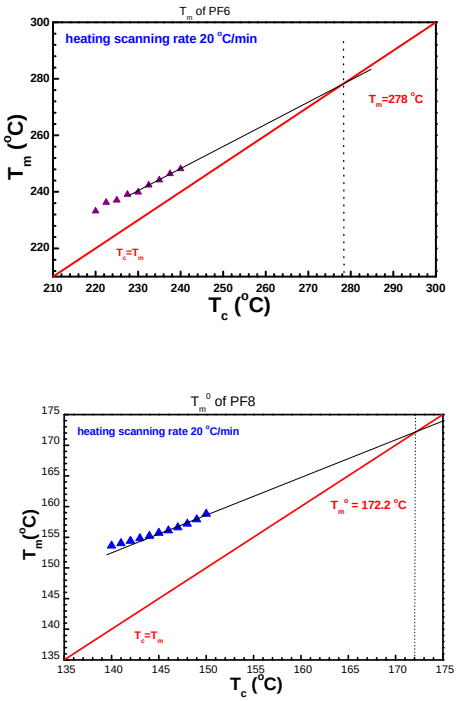

Figure 1. By means of the plot of crystallization temperature vs. melting temperature (Hoffman-Weeks analysis) the equilibrium melting of polyflourenes are estimated.(a)Ten of PFH annealing temperature between 220 to 240 ^{o}C (b) Ten of PFO annealing temperature between 140 to 150 ^{o}C. By extrapolating these data to $T_c = T_m$, the equilibrium melting was determined. As the result, T_m^{o} of PFH is 278 ^{o}C, T_m^{o} of PFO is 172 ^{o}C.

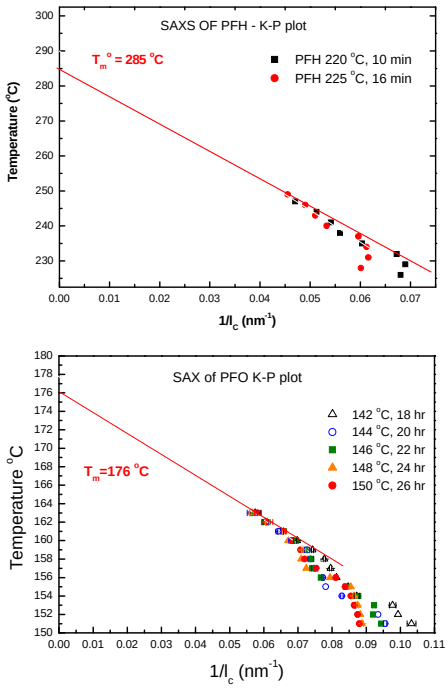

Figure 2. By Kratky-Porod approximation, crystalline lamellar thickness from SAXS profiles can be obtained at high temperatures, where there are only limited number of discrete crystalline lamellae dispersed in the melt matrix.PFH annealed at 220 ^{o}C for 10min, and 225 ^{o}C for 16 min. PFO annealed at five temperature, 142 ^{o}C, 18 hr; 144 ^{o}C, 20 hr; 146 ^{o}C, 22hr; 148 ^{o}C, 24 hr; 15 ^{o}C, 26 hr. Plot of onset melting temperature versus the reciprocal of lamellar thickness the equilibrium melting point was determined. As the result, the extrapolated T_m^{o} of PFH is 285 ^{o}C, and the T_m^{o} of PFO is 176 ^{o}C.

To determine the equilibrium melting point of the series of polyfluorenes, the Kratky-Porod approximation and Hoffman-weeks analysis were used in this study. By Kratky-Porod approximation the Tm* of PFO is 176 ^{o}C, and PFH is 285 ^{o}C. And by using of Hoffman-weeks plot the Tm* of PFO is 172 ^{o}C, PFH is 278 ^{o}C. As the result, the equilibrium melting point obtained from Hoffman-Weeks analysis is slightly lower than that of Kratky-Porod approximation.