Lyotropic Liquid Crystallinity of Linear and Star Poly(quinoxaline-2,3-diyl)s: Isotropic-Liquid Crystal Phase Equilibria in Tetrahydrofuran

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Lyotropic liquid crystallinity was investigated for a concentrated solution of linear and 3-arm star poly(quinoxaline-2,3-diyl), of which the main chain has a rigid helical nature in tetrahydrofuran. Four samples for both linear and star chains were prepared with the weight-average molar mass M_w ranging from 50 to 250 kg mol^{-1}. Two phase boundary concentrations, c_I between the isotropic and biphasic regions and c_A between the biphasic and anisotropic regions, were determined as a function of M_w. The resultant c_I and c_A for the linear chain increased gradually with lowering M_w. This behavior was successfully explained by the latest theory for lyotropic liquid crystallinity based on the scaled particle theory (SPT) for the wormlike spherocylinder. The phase diagram for star chains, on the other hand, has similar c_I and c_A at the high Mw region but increased abruptly with decreasing M_w. It can be explained by a modified SPT theory in which we assumed that two or three arm chains align parallel in the nematic phase. A small-angle X-ray scattering pattern for the concentrated solutions indicated that the smectic superstructure was contained at least a little in the liquid crystalline phase and the diffraction peak of the linear chains corresponded to the total chain length, whereas the *d*-spacing for the star chain is almost the same as that for the arm length, supporting the abovementioned assumption for the modified SPT.

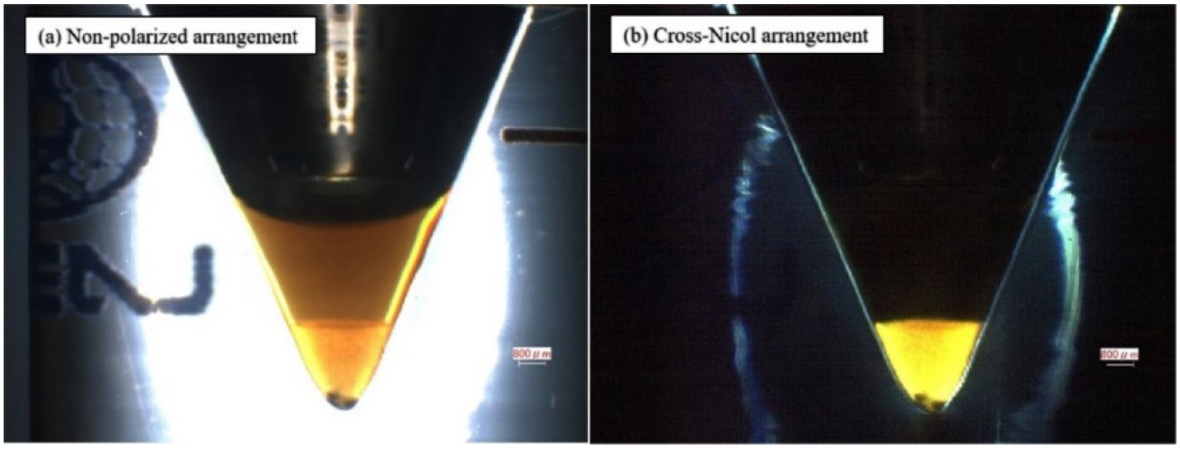

Photo 1. Photographs for coexistence phases of A3PQ-80 (M_w = 89 kg mol^{-1}) in THF at 25 °C (c_0 = 0.398 g cm^{-3}). (a) Nonpolarized image. (b) Crossed-Nicols image. Reprinted with permission from *Macromolecules* **52**, 3158 (2019). Copyright (2019) American Chemical Society.

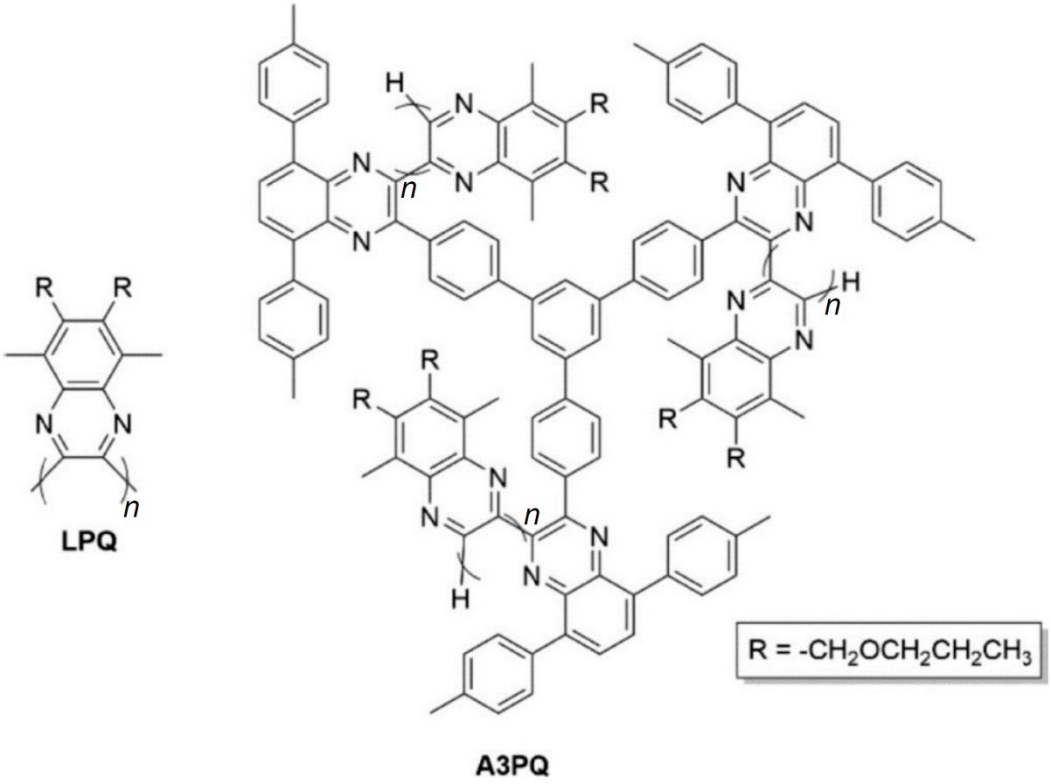

Fig. 1. Chemical Structures of Linear (LPQ) and star (A3PQ) poly(quinoxaline-2,3-diyl). Reprinted with permission from *Macromolecules* **52**, 3158 (2019). Copyright (2019) American Chemical Society.

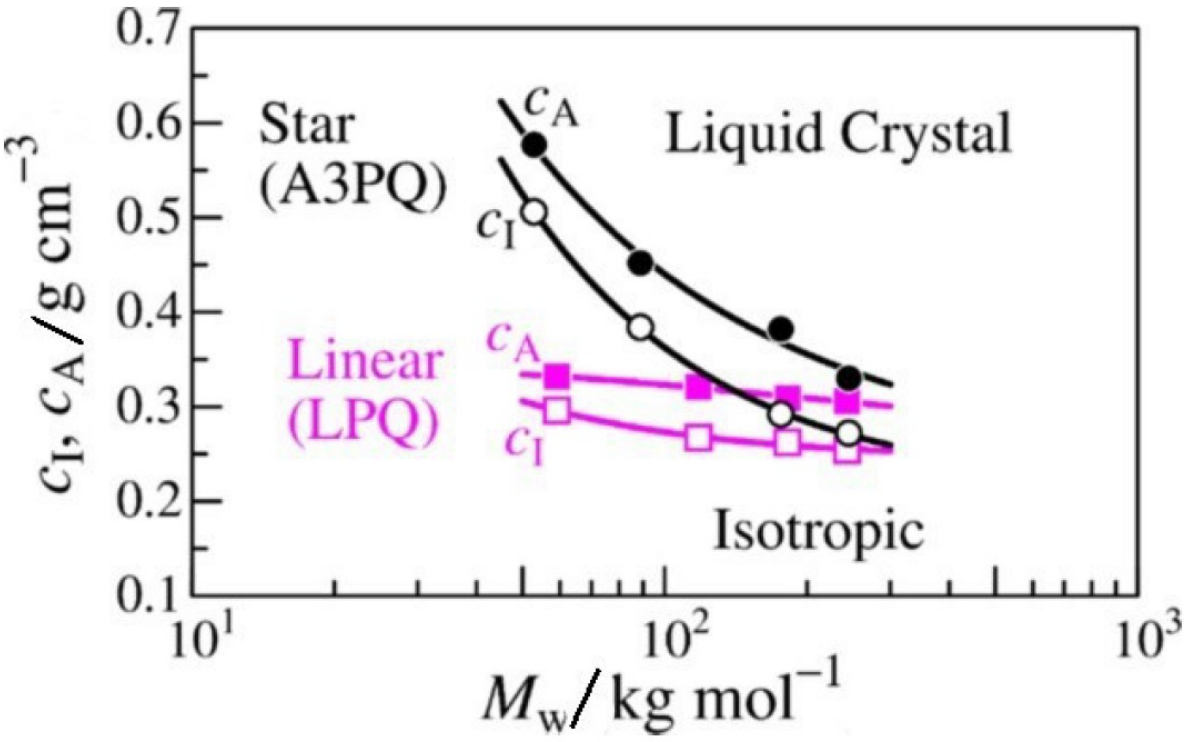

Fig. 2. M_w dependence of c_I (unfilled symbols) and c_A (filled symbols) for LPQ (squares) and A3PQ (circles) in THF at 25 °C. Reprinted with permission from *Macromolecules* **52**, 3158 (2019). Copyright (2019) American Chemical Society.