Liquid Crystalline Properties of Cellulose Derivatives

Part II ; Trimethylsilyl - and Phenylacetoxy-cellulose

Sun Kyung Kim, Sung Il Hong, and Tae Jin Kang

Department of Textile Engineering,
Seoul National University

The liquid crystalline properties of trimethylsilyl cellulose (TMSC) and phenylacetoxy cellulose (PAC) in 1,1,2-trichloroethane were studied.

The syntheses of these cellulose derivatives were examined using various analytical tools and their degree of substitutions were also determined. Both TMSC and PAC formed lystropic liquid crystalline phase in 1,1,2-trichloroethane solvent. The liquid crystalline texture of the solutions were observed with a polarizing microscope and the birefringence were determined using a refractometer.

Optical observation showed that the concentrated solutions reflected the iridescent colors resulting from the cholesteric nature of the mixture. The birefringence of the solution was found to be independent of the concentration at highly anisotropic phases.

The rheological responses of the lystropic cellulose derivatives showed remarkable differences in the measured values such as dynamic viscosity (η'), elasticity parameter ($G'/2G''$), and loss tangent ($\tan \delta$) at the vicinity of the critical - and saturation-concentrations. Above the saturation concentration, the elasticity increased at lower frequencies, but at higher frequencies it decreased. This may be attributed to a significant deformation of orientational order of cholesteric liquid crystalline domain at higher frequencies.

From the rheological observations of the solution it is concluded that the rigid phenyl group in PAC may be an additional advantage to stabilize the mesophase domains, however, the bulky and flexible side chains in TMSC may cause the liquid crystalline domains to be deformed easily under high shear deformation rate.