LYOTROPIC MESOPHASES OF CELLULOSE IN THE AMMONIA/AMMONIUM THIOCYANATE SOLVENT SYSTEM

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The liquid crystalline phase behavior of cellulose in the NH_3/NH_4SCN solvent has been studied as a funtion of cellulose concentration and solvent composition at 25°C. The concentrations for the incipience of mesophase formation and for wholly anisotropic phase formation were determined at various solvent compositions. The biphasic gap in terms of a ratio between the minimum cellulose concentration for wholly anisotropic phase formation and that for mesophase formation decreased from 5.25 to 2.06 when NH_4SCN concentration increased from 70.0 to 74.0% (w/w). The minimum cellulose concentration for mesophase formation was in the range of 0.02 to 0.045 in volume fraction with variation of solvent composition. The cellulose contration difference between the respective phases decreased with increasing NH_4SCN concentration in the solvent up to 75.5 wt.%(40.8 mole %). The partitioning behavior was explained in terms of polymer-solvent interaction. The liquid crystalline solutions formed under most conditions studied were twisted cholesterics that typically form from chiral mesogens. The helicoidal pitch of these cholesteric phase was higher for solvents that were richer in NH_4SCN and for the solutions having lower cellulose contrations. Nematic phases which may be described, as untwisted cholesterics, are easily prepared from solutions in which the cellulose concentration range was 8-16% at the specific

solvent composition of 75.5% of NH_4SCN. Experiments indicate that this system yields a nematic phase under conditions in which cellulose-cellulose interactions are suppressed. Fibers have been extruded from both cholesteric and nematic solutions. Those formed from the nematic solutions were more highly oriented, more fibrillar in texture and apparently stiffer than those formed from cholesteric solutions. The former had moduli that were comparable to that of Fortisan®, a strong regenerated cellulose fiber.