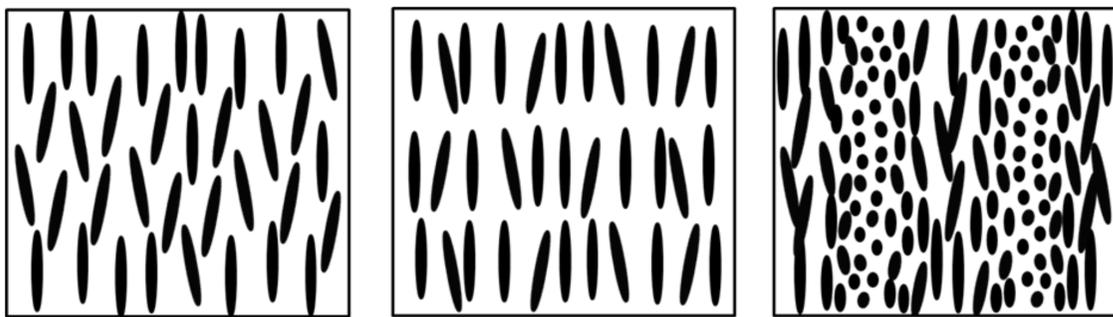


Structural Ordering and Self-assembly in Mesogenic Cellulose Nanocrystal Phases

Cellulose nanostructures have been found to possess remarkable optical properties derived from their ability to form mesogenic phases in liquid solutions (Gray, 1992). These phases are currently being used to produce iridescent thin films (Fernandes, 2013). The formation of cellulose nanocrystals (CNCs) into mesogenic phases occur via a self-assembly process that for cellulose produce nematic and cholesteric phases (MacLachlan, 2013).



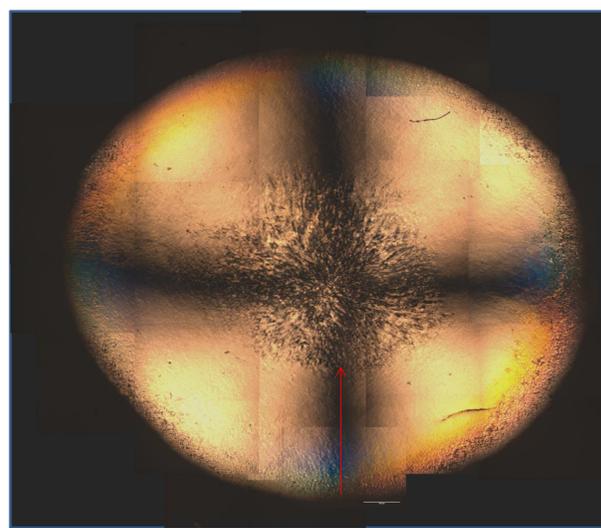
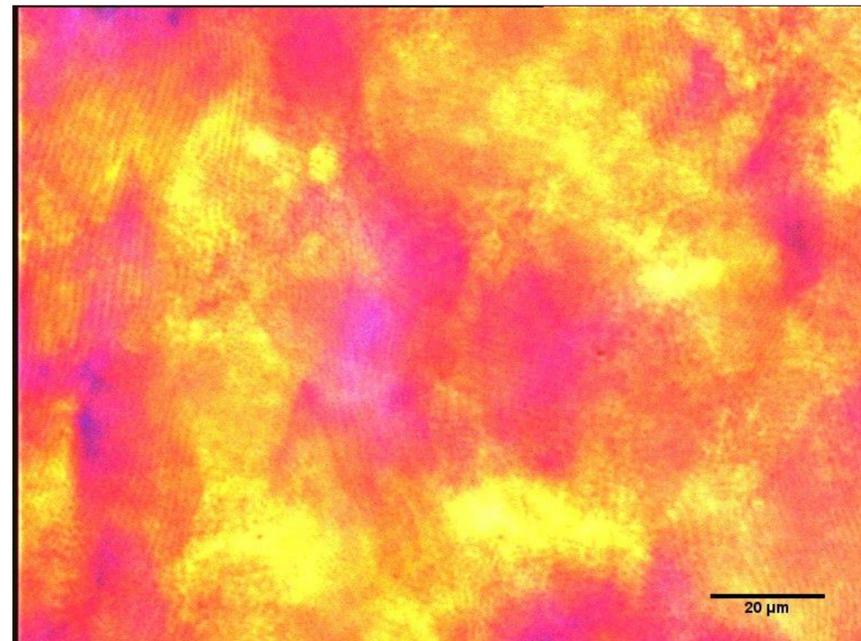
(a) Nematic

(b) Smectic

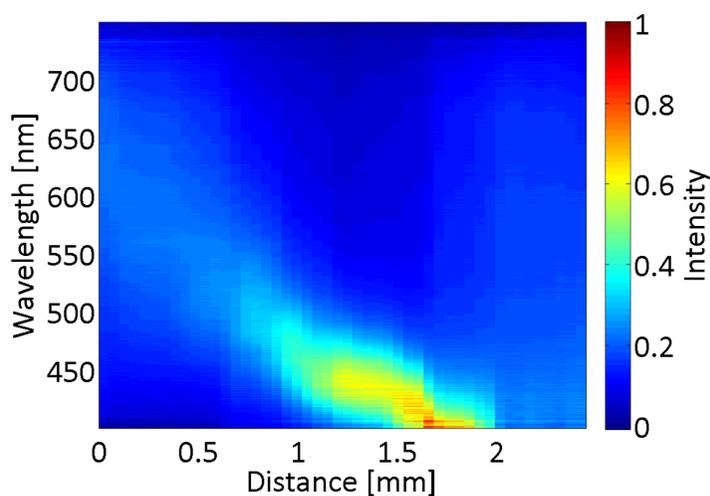
(c) Cholesteric

Above: Mesogenic phases formed by liquid crystal polymers.

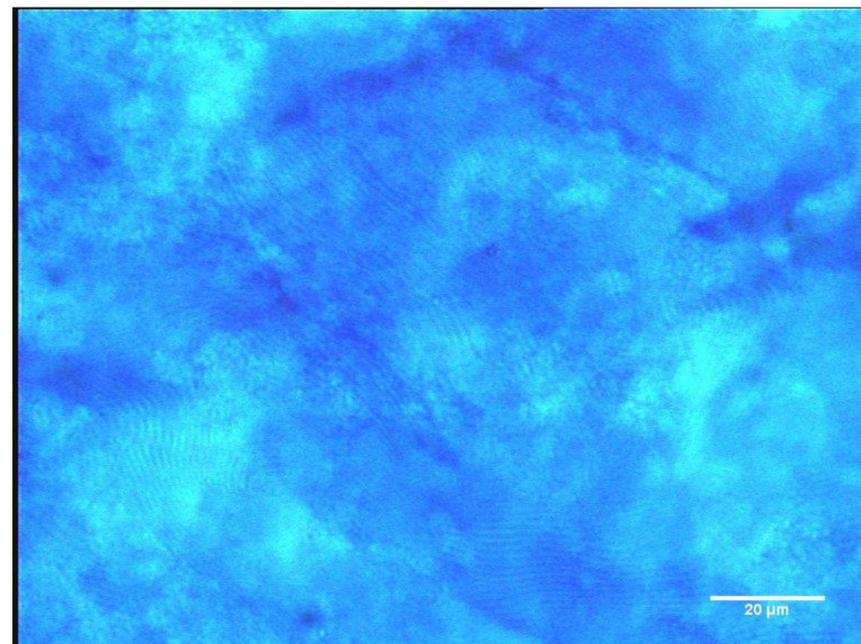
Right: Polarised optical microscope image of a Cellulose nanocrystal thin film taken using a full 530nm retardation plate.



Drop Spectra



Left: CNC thin film between crossed polars. The red arrow indicates the line and direction from which the spectra presented in the colour plot was taken. The plot shows a progressive blue shift with an increasing intensity towards the mid point where CNCs are less concentrated.



Above right: The pink and yellow colours seen are produced by cellulose nanocrystals that lie perpendicular to the direction of the polarised light. The pink colour is produced by an isotropic arrangement of CNCs. The yellow is where a nematic phase has formed with the fast optical axis aligned at a 45° angle to the analyser in the microscope. Nematic arrangements aligned 45° in the opposite direction appear blue. The finger print like patterns are indicative of cholesteric phases where CNCs that have their slow optical axis aligned parallel to the electromagnetic field appear as the darker lines.

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