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Resolving Defect Formation and Dynamics of the Smectic-A Mesophase[1]

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The formation and interaction of defects in liquid crystalline (LC) phases are fascinating both from a fundamental and applied perspective. Smectic LC phases, which have both orientational and translational order, exhibit relatively complex defect structures [1] and dynamics compared to lower order nematics (possessing only orientational order). A simple example of this complexity is that smectic disclination dynamics differ from those of nematics due to additional topological constraints imposed by the presence of translational order. A far less simple example is the presence of focal conic defect domains [1] that arise due to smectic elasticity favouring layer curvature over compression/dilation. Direct experimental observation of defect formation and dynamics of the smectic-A mesophase is challenging due to them occurring on the nano-scale. Theoretical approaches have had substantial success, particularly extensions of the tensorial Landau-de Gennes free energy for nematics [2] to smectic order [3]. Modelling dynamics via the time-dependent Landau-Ginzburg equation [4] has been shown to resolve topologically consistent smectic dynamics which agree with experimentally determined phase transition kinetics [5]. This talk will present an overview of recent research in this area, including the effects of an external field. The results of this research support the use of a relatively complex model of smectic dynamics. Specifically, it is shown that couplings between both short- and long-range orientational/translational order play an important role in smectic defect formation and interaction.

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