Interplay between growth mechanisms and elasticity in liquid crystalline nuclei.

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1. INTRODUCTION

A first order phase transition from an undercooled isotropic phase to an ordered phase usually yields complex morphologies, resulting from the competition between growth and diffusion. Fundamental issues, such as the non-linear dendritic growth of crystals, are however well understood and several numerical methods now satisfactorily reproduce the main experimental features of the growth patterns of crystals. On the contrary, the growth forms of soft condensed phases and their dynamics are often very qualitatively described. The main reason is that the softness of the nuclei introduces couplings -difficultly handled- between the growth mechanisms, the elasticity field and the appearing of macroscopic defects. I will illustrate some underlying mechanisms and their role on the formation of the two typical out-of-equilibrium patterns of smectic liquid crystal phases: the “batonnets” and the cylindrical filaments.

2. INTERFACE ANISOTROPY, ELASTICITY AND DENDRITIC GROWTH

Volumic faceting [1] was introduced to describe how a lamellar phase responds to an anisotropy in its interface energy by deforming when the interface orientation is imposed. This mechanism controls the change of texture of a slab of lamellar phase growing from a flat substrate with hybrid anchorings [2, 3]. A recent work [4] has shown that a similar mechanism could explain the change of texture during the growth of lamellar phase nuclei and the formation of onions. We have closely examined the dynamics of a sponge-to-lamellar phase transition which tend to form complex “ batonnets” rather than onions. We show that the observed intermittent dynamics and the unusual growth patterns can be explained by a temporal succession of volumic faceting mechanisms and a standard dendritic growth [5].

3. FORMATION OF FILAMENTS: THE ROLE OF THE INTERFACE AREA

Apart from the “batonnets”, layered systems often form filaments (called myelins in lyotropic systems) when the anchoring at the interface is preferably homeotropic. The formation of filaments has been observed in various situations such as the isotropic-to SmA phase transitions or during the hydration of surfactants. We have recently shown that filaments could be formed in nematic [6] and smectic emulsions in water, without any volume change by using surfactants that spontaneously spread on the liquid crystal/water interface. The dynamics of formations and the main properties of the filaments will be described.

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