421c Solidification Vs. Precipitation: Comparison between the Morphology of a Growing Interface by Two Different Mechanisms

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A solid that grows from a liquid can do so in more than one manner. One way is by the application of a temperature gradient with the rejection of latent heat occurring through either or both adjoining phases. Another way is via isothermal precipitation from a supersaturated solution. In both ways of growing a solid an erstwhile planar interface can suddenly lose stability and change its shape as a control variable is advanced beyond its critical value. The factors leading to such instabilities have to do with the direction and magnitude of temperature or concentration gradients at the interface as well as the interfacial tension. In this talk we will compare the instability of an initially planar interface during solidification and precipitation. While the underlying causes of instability in both of these growth mechanisms are very similar, the dependence of the growth rates of the interface roughness on the wavelengths of the perturbations for solidification and precipitation has dissimilar features, different physics and different implications. In solidification the latent heat may be rejected to both phases leading to a stabilizing role played by the solid; however in precipitation mass is transported entirely via the liquid phase and the solid phase offers no stabilization whatsoever. This implies that a graph of growth control variable versus disturbance wave number may exhibit a minimum in the case of solidification while it must always increase monotonically in the case of precipitation. This, in turn leads to the fact that if one were to conduct a growth experiment in a container with a finite dimension that is perpendicular to the growth direction, multiple interfacial protrusions would be seen at the onset of instability in solidification, but only a single wave will be seen in the case of precipitation. As a part of this talk we aim to show how these features as well as other interesting physics can be gleaned from fairly simple models for growth.