DYNAMICS OF GRAVITY AND CAPILLARY DRIVEN INSTABILITIES AT SOFT INTERFACES

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Soft solids with low elasticity such as gels are susceptible to interfacial instabilities that are typically observed in fluids. This occurs because, like fluid surfaces, small perturbations on soft solids can grow exponentially under capillary or gravity forces destabilizing the solid interface. We study the dynamics of two such instability mechanisms, i) Rayleigh-Taylor instability of soft solid in a cylindrical container driven by its self-weight, ii) Plateau-Rayleigh instability in soft cylinders driven by the capillary pressure. For ii) we study the cases of a solid cylinder and a cylindrical cavity. In all the cases we use governing equations of linear elastodynamic assuming soft viscoelastic solids with non-trivial surface tension at the interface. To model solid viscoelasticity we use the power law rheology. For each cases we derive the dispersion relations which relate the unstable growth rates of a particular wavenumber to the nondimensional parameters that represents the effect of relevant forces. This allows us to find the range of unstable wavenumber for the different cases, as well as determining the wavenumber and growth rate of the most unstable mode. Our results show good agreement with available experimental data.

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