

MECHANICAL ENGINEERING PhD SEMINAR

Thursday, January 22, 2026, at 13:30, Lady Davis Building, Auditorium 250

Instabilities in nanofluid layers

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Surface tension-driven phenomena are ubiquitous in nature and in many industrial applications. As with technological advancement, the transport process often involves complex fluids, such as colloidal dispersions or nanofluids, polymer liquids, and two-phase systems. Nanofluids represent colloidal dispersions made of a mixture of a base fluid and nanoparticles of diameter d_p^* between 10 and 100 nm.

We investigate the onset of thermosolutal instabilities in a moderately dense quiescent nanofluid layer with a deformable interface in the presence of a gravity field and the Soret effect. The onset of various instabilities is investigated for cases of both cooling and heating at the solid substrate. We find the emergence of monotonic solutocapillary instability in the case of cooling at the substrate, where the disturbance minima exhibit competition with variation in the gravity field and the Soret effect.

Interestingly, the heating at the substrate case reveals more diverse instability mechanisms. In this case, we find the emergence of both monotonic and oscillatory thermocapillary instabilities. Furthermore, we present the onset of solutal buoyancy instability due to unstable density stratification induced by the Soret effect. Transitions from the monotonic to oscillatory thermocapillary instability are reported. Notably, we reveal a novel transition from monotonic to oscillatory thermocapillary instability due to the variation in the strength of thermal conductivity stratification coupled with the Soret effect. Additionally, we present the onset of long-wave thermosolutal instabilities in two different regimes of the dimensionless surface tension number.

Finally, we highlight the impact of the non-monotonic variation of surface tension with the nanoparticle concentration in the presence of interfacial kinetics and the stratification of thermophysical properties of the nanofluid.

Note: the seminar will be given in English