Influence of discharge parameters on the mode-coupling instability in two-dimensional complex plasma crystals

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The dependence of the mode-coupling instability threshold in two-dimensional complex plasma crystals is studied. It is shown that for a given microparticle suspension at a given discharge power there exist two thresholds in pressure. Above a specific pressure p_{cryst}, the monolayer is always in the crystal phase. Below a specific pressure p_{MCI}, the crystalline monolayer undergoes the mode-coupling instability and the monolayer is in the fluid phase. In between p_{MCI} and p_{cryst}, the crystal will be in the fluid phase when increasing the pressure from below $p$min until it reaches $p$max where it recrystallises, while it remains in the crystal phase when decreasing the pressure from above $p$max until it reaches $p$min. A simple self-consistent sheath model is used to calculate the rf sheath profile, the microparticle charges and the microparticle resonance frequency as a function of power and background argon pressure. Combined with calculation of the lattice modes the main trends of p_{MCI} as a function of power and background argon pressure are recovered. The threshold of the mode-coupling instability in the crystalline phase is dominated by the crossing of the longitudinal in-plane lattice mode and the out-of plane lattice mode induced by the change of the sheath profile. Ion wakes are shown to have a significant effect too.

References

[1] L. Couëdel and V. Nosenko, *Stability of two-dimensional complex plasma monolayers in asymmetric capacitively-coupled radio-frequency discharges*, Phys. Rev. E **105**, 015210 (2022)