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(I) 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_{MCI} until it reaches p_{cryst} where it recrystallises, while it remains in the crystal phase when decreasing the pressure from above p_{cryst} until it reaches p_{MCI} . 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)

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