

We present molecular dynamics (MD) simulations in Yukawa system of the formation and evolution of a crystallization wave. We have found the coexistence of various lattice types (including metastable ones) behind crystallization wave front. Local order analysis shows the presence of fcc, bcc and hcp phases - it is a clear manifestation of a non-equilibrium phase transition in the system.

Kinetic observations of crystal growth in real time are possible by using complex plasmas. A plasma crystal is first melted into a disordered liquid-like phase (e.g., by a short increase of the plasma discharge power). Afterwards, the system starts to recrystallize. Often this occurs in the form of a crystallization wave (CW) propagating in the direction of the decreasing particle density, against gravity. We provided MD simulations of the crystallization process, revealing the qualitative features observed in experiments. The temperature field in the system is shown on the top figure. It is color-coded (temperature rises from black to yellow). The front has a well developed fractal structure, with an abrupt temperature drop within the transition layer (blue) from the liquid/gaseous (green-yellow) to the crystalline (black) phase. After the CW front passed, (right figure shows particle density behind CW front, the spatial dependence of mean energy of the layers is depicted on the inner figure) the crystalline structures formed behind the front revealing a sequence of transitions from one lattice configuration to another. Bottom figures demonstrate some results of the local order analysis of the crystallized region. Left figure shows the spatial distribution of bcc, fcc, hcp and liquid domains in the region. The right figure presents local analysis of the coupling parameter, showing how the crystallization process evolves versus time.

