Shearing the cold dusty plasma liquid at discrete level

Chi Yang, Meng Chun Chen, and Lin I
Department of Physics and Center for Complex Systems, National Central University, Jhongli, Taiwan 32001, Republic of China

aztme@hotmail.com

Microscopically, the liquid around freezing is not completely disordered. It consists of various sized crystalline ordered domains coexisting with surrounding defect clusters. The crystalline ordered domains partially process solid-like properties and drastically change the microscopic response to stress. Our recent study showed that, comparing to the hot liquid, the cold liquid are much less vulnerable to thermal agitation, but are still able to rearrange their microstructure through domain rupture, rotation and healing processes [1]. How these basic thermal induced processes are altered under further external shear stress is still an elusive fundamental issue. In this work, the above issue is experimentally addressed in the cold 2D dusty plasma liquid, formed by negatively charged dust particles suspended in a low pressure rf discharge. A laser beam passing through the center of the liquid is used to generate shear. Dust particle trajectories are directly tracked through video microscopy. Bond dynamic analysis is used to analysis the domain rotating and bond breaking in the structural rearrangement process. Under weak shear stress, unlike the shear banding in the hotter liquid, anomalous shear banding without localized heating and high rate structural rearrangement is observed. The causality of the shear induced structural rearrangement in the regions from the directly sheared region to the remote region is discussed.