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Physics behind the droplet detachment from a surface[1] NEDA OJAGHLOU, ALI MOGHADAM, DUSAN BRATKO, HOOMAN V. TAFRESHI, ALENKA LUZAR, Virginia Commonwealth University — The study of liquid droplet adhering to flat solid surfaces has received considerable attention due to its importance in many different engineering applications, such as filtration, spray coating, and oil recovery, liquid water removal in PEM (proton exchange membrane or polymer electrolyte membrane) fuel cells, and resuspension of an aerosol from solid surfaces. In this project, we focus on understanding how the adhesion of the droplet on a hydrophilic surface affects the detachment behavior and how the applied force can change the residue of droplet on the flat surface. We analyze the process using atomistic molecular dynamic (MD) simulations. We address the fundamental questions about the droplet size dependence of the minimal force capable of detaching a droplet from the surface, and the effects of droplet size and applied force on the amount of the liquid residue left on the surface after the detachment. We perform multiple MD simulations for droplets on a smooth hydrophilic surface at varied system sizes and applied forces. Our modelling studies of the droplet breakup show the amount of residual water to be maximal near the minimum detachment force strengths whereas a complete or near-complete detachment of the droplet can be achieved with very strong force. Because of its fundamental appeal and importance for applications, we hope the work will inspire experimental investigations and theoretical analyses of liquid retention and its control through varied stimuli for droplet detachment from the surface.

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