The 95th GREEN Seminar

Spontaneous Rise of Reacting Microdroplets

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Spontaneous drop departure from a surface is a crucial process in both natural and technological systems. The process plays a significant role in collecting water from air, harvesting energy from rainfall, and creating self-cleaning and anti-icing surfaces. Recently, the primary strategy to enhance drop mobility is to exploit various bio-inspired surfaces that are decorated with sophisticated micro- and nanotextures. The purpose is to reduce the adhesion force between the drop and the surface. Here we report a remarkable phenomenon wherein a dissolving drop on a substrate rises in the water only after it has diminished to a much smaller size, though the buoyancy is smaller according to Archimedes' principle. The drop consisting of a polymer solution reacts with the acid in the surrounding, yielding a water-soluble product. During drop dissolution, water-rich microdroplets form within the drop, merging with the external aqueous phase along the drop-substrate boundary. Two key elements determine the drop rise dynamics. The first is the stick-jump behavior during drop dissolution. The second is that buoyancy exerts a strong enough force on the drop, while the stick-jump behavior is ongoing. The time of the drop rise is controlled by the initial size and the reaction rate of the drop. This novel mechanism for programmable drop rise may be beneficial for many future applications, such as microfluidics, microrobotics, and device engineering where the spontaneous drop detachment may be utilized to trigger a cascade of events in a dense medium.

Venue: Auditorium, 1F, WPI-MANA Bldg., Namiki-site

Date: Friday January 19th, 2024

Time: 13:30-14:30

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