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Droplet pairing and coalescence control for generation of combinatorial signals EUJIN UM, Princeton University, MATTHEW ROGERS, Firmenich Inc., HOWARD STONE, Princeton University — A co-flowing aqueous phase with an immiscible oil phase in a microchannel generates uniformly spaced, monodisperse droplets, which retain their shape by not touching each other or by being stabilized with surfactants at the oil-water interface. However, droplet coalescence is required in many advanced applications, which can be achieved by a complex channel geometry or size differences in the droplets, and as well as by procedures to reduce the effect of a surfactant. These approaches, again, hinder the stability of droplets further downstream. We designed a microchannel which consistently inserts gas-bubble between droplets so that pairing and coalescence of droplets occurs even in the presence of surfactant, and yet prevents unwanted merging with other droplets. Aqueous droplets placed between the bubbles alter their relative speeds and spacing, and consequently we study the change in the number of droplet pairings in relation to the characteristics of the bubbles and the volume of aqueous droplets. By integrating this approach with droplets of different materials, we can program the output sequence of droplet compositions, and such complex combinatorial signals generated are aimed for concentration gradient generation and dynamic stimulation of biological cells with chemicals.

Eujin Um
Princeton University

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