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Formation and evolution of thin water films encapsulating oil droplets crossing an oil-water interface. JOSEPH KATZ, OMRI RAM, Johns Hopkins University — This study examines phenomena occurring as mm-scale oil droplets rise through water, cross an oil-water interface, and then coalesce with a layer of the same oil. Inline holography and planar laser induced fluorescence are used for examining interfaces involving layers of silicone oil of different viscosity and hexadecane above both purified and nearly refractive index-matched sugar water. They show that for all cases, after crossing the interface, thin water films remain around these droplets, preventing them from mixing with the bulk oil. Subsequently, in a slow process, film segments located close to the contact point with the interface are attracted to the bulk water, presumably by electrostatic forces, causing the droplet to flatten, and creating a kink, where the film begins to break up into submicron droplets. The region of submicron droplets propagates from the peripheral kinks inward to the center of the droplet, and they begin to diffuse. These processes occur in less than one minute for a 4 cst oil, and about one hour for a 50 cst oil, preventing the merging of the droplet with the surrounding oil for much longer than previously presumed. These phenomena do not occur when water droplet descends across the oil-water interface, namely oil films do not form.

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