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A new perspective on the wetting of a solid surface by the drops of an emulsion (I)

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Traditionally, the wetting of a solid surface by the drop of an emulsion has been thought to be mediated by the formation of a liquid bridge that connects the drop and the surface. In the current work, we experimentally show the spreading of a drop on a surface follows a different, new mechanism. Experiments were conducted for liquid-liquid systems, wherein drops of higher density (glycerol) were allowed to settle under gravity in a lighter polymeric liquid phase (silicone oil) under conditions of small Bond numbers. The approach of the drop towards the substrate was visualized using Reflection Interference Contrast Microscopy (RICM), and the details of the film drainage dynamics and the spreading process of the drop on the surface were recorded. The film shapes obtained were compared with predictions from scaling analysis. The temporal variation of the minimum film heights matched theoretical expectations, until the height reached few tens of nanometers, at which point a stable film was formed. Following this, deformable islands were observed to grow on the substrate, one of which eventually merged with the parent drop to complete spreading. The reasons for the arrest of film drainage and the appearance of the islands will be discussed. The fundamental mechanism discovered here will ultimately guide the tailoring of emulsion-based coatings or paints to have predefined spreading times.

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