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Formation of surface nanodroplets under controlled flow conditions DETLEF LOHSE, Univ of Twente, XUEHUA ZHANG, RMIT Melbourne and Univ of Twente, ZIYANG LU, RMIT Melbourne, HUANSHU TAN, Univ. of Twente, LEI BAO, RMIT Melbourne, YINGHE HE, James Cook University, Townsville City, CHAO SUN, Univ. of Twente — Nanodroplets on a solid surface (i.e. surface nanodroplets) have practical implications for high-throughput chemical and biological analysis, lubrications, lab-on-chip devices, and near-field imaging techniques. Oil nanodroplets can be produced on a solid-liquid interface in a simple step of solvent exchange in which a good solvent of oil is displaced by a poor solvent. In this work, we experimentally and theoretically investigate the formation of nanodroplets by the solvent exchange process under well-controlled flow conditions. We find significant effects from the flow rate and the flow geometry on the droplet size. We develop a theoretical framework to account for these effects. The main idea is that the droplet nuclei are exposed to an oil oversaturation pulse during the exchange process. The analysis gives that the volume of the nanodroplets increases with the Peclet number Pe of the flow as $\propto Pe^{3/4}$, which is in good agreement with our experimental results. In addition, at fixed flow rate and thus fixed Peclet number, larger and less homogeneously distributed droplets formed at less narrow channels, due to convection effects originating from the density difference between the two solutions of the solvent exchange.

Detlef Lohse
Univ of Twente

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