Formation and dynamics of in-drop micro/nanobubbles from Interfacial Hydrogen-Evolution Reaction

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The compartmentalization of chemical reactions within droplets has advantages in low costs, reduced consumption of reagents, and increased throughput. Reactions in small droplets have also been shown to greatly accelerate the rate of many chemical reactions. The accelerated growth rate of nanobubbles from nanodroplet reactions is demonstrated in this work. The gaseous products from the reaction at the nanodroplet surface promoted nucleation of hydrogen nanobubbles within multiple organic liquid nanodroplets. The nanobubbles were confined within the droplets and selectively grew and collapsed at the droplet perimeter, as visualized by microscopy with high spatial and temporal resolutions. The growth rate of the bubbles was significantly accelerated within small droplets and scaled inversely with droplet radius. The acceleration was attributed to confinement from the droplet volume and effect from the surface area on the interfacial chemical reaction for gas production. The results of this study provide further understanding for applications in droplet enhanced production of nanobubbles and the on-demand liberation of hydrogen.