Acoustic Evaluation of Droplet Size Distribution in Magnetic Pickering Emulsions

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Abstract. Many naturally occurring and industrial systems are multiphase, requiring accurate modeling to predict their behavior under external stimuli, such as ultrasound. The Epstein-Carhart-Allegra-Hawley (ECAH) theory is commonly used to describe ultrasound scattering and attenuation in two-phase systems. It becomes less reliable for more complex three-phase systems, such as Pickering emulsions, which include a continuous phase, a dispersed phase, and solid particles forming stabilizing shells around droplets. To better capture the acoustic behavior of such systems, the Anson-Chivers core-shell model offers a more suitable theoretical framework.
In this work, we use an acoustic spectrometer to investigate the ultrasound attenuation of both non-stabilized and magnetic particle-stabilized oil-in-oil emulsions. The experimental attenuation spectra in the frequency range of 1–100 MHz were analyzed using the core-shell model to evaluate droplet size distribution and shell thickness to match the experimental data.
The results show that prediction accuracy is better for lower content of droplets. Size distribution was mainly influenced by the concentration of stabilizing particles and the number of stabilizing layers. Therefore, the core-shell model, which accounts for the contribution of droplets' shells, offers a better evaluation of solid particle-stabilized systems.

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