The Behaviour of Particle-Stabilized Droplets under Ultrasound and Magnetic Fields

Rafał Bielas, Tomasz Kubiak, Filip Ratajczak, and Arkadiusz Józefczak

Chair of Acoustics, Faculty of Physics and Astronomy, Adam Mickiewicz University in Poznań Uniwersytetu Poznańskiego 2, 61-614 Poznań, Poland

[a] Corresponding author: rafal.bielas@amu.edu.pl

Abstract. Droplets covered by solid particles – either immersed in the outer liquid phase (Pickering droplets) or residing outside the liquid (liquid marbles) – have gained interest due to their potential in medicine and industry. For instance, they can be used for transportation of fragile substances or act as tiny platforms where facilitated chemical reactions occur. The droplets responsive to stimuli are especially considered in fabricating tunable Pickering emulsions and magnetic liquid marbles. In our studies, we utilize magnetic nanoagents for two main purposes – as agents that enable controlled locomotion due to the action of magnetic field gradients, and as means that enable controlled magnetic heating of the particles forming the droplet shell. The results show that the induced temperature rise during magnetic heating reaches values sufficiently high to allow for structural changes of the droplet shell while maintaining its integrity. However, the use of ultrasound field is also possible for Pickering droplets and liquid marbles for their deformation and manipulation, as the acoustic response of such microstructures is significant. Both ultrasound and magnetic fields thus offer a promising method for precise control of particle-stabilized droplets which could be desired for the improved using of such structures in medical and technological applications in the future.

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[1] R. Bielas, T. Kubiak, P. Kopcansky, I. Safarik, A. Józefczak, Tunable particle shells of thermo-responsive liquid marbles under alternating magnetic field. *Journal of Molecular Liquids*, 2023, 391: 123283.

[2] F. Ratajczak, B. Jameel, R. Bielas, A. Józefczak, Ultrasound control of Pickering emulsion-based capsule preparation, *Sensors*, 2024, 24.17: 5710