

Early Detection of Instability in Emulsions via Diffusing Wave Spectroscopy

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Abstract : The food, personal care, and cosmetic industries are seeing increased consumer demand for more sustainable and innovative ingredients. When developing new formulations incorporating such ingredients, stability is one of the first criteria that must be assessed, and it is thus of great importance to have a method that can detect instabilities early and quickly. Diffusing Wave Spectroscopy (DWS) is a light scattering technique that probes the motion, i.e., the mean square displacement (MSD), of colloids, such as nanoparticles in a suspension or droplets in emulsions. From the MSD, the rheological properties of the surrounding medium can be determined via the so-called microrheology approach. In the case of purely viscous media, it is also possible to obtain information about particle size. DWS can thus be used to monitor the size evolution of particles, droplets, or bubbles in aging dispersions, emulsions, or foams. In the context of early instability detection in emulsions, DWS offers considerable advantages, as the samples are measured in a contact-free manner, using only small quantities of samples loaded in a sealable cuvette. The sensitivity and rapidity of the technique are key to detecting and following the ageing of emulsions reliably. We present applications of DWS focused on the characterization of emulsions. In particular, we demonstrate the ability to record very subtle changes in the structural properties early on. We also discuss the various mechanisms at play in the destabilization of emulsions, such as coalescence or Ostwald ripening, and how to identify them through this technique.

Keywords : instrumentation, emulsions, stability, DWS

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