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Abstract

Foresight – future consumer scenarios

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The structure and formation of dairy products provide systems in which nano-scale components undergo complex interactions to form structures with a multitude of macroscopic properties. A combination of Super-resolution imaging and Ultrasound spectroscopy has been applied to obtain an overview of the dynamics, interactions and structural properties of reconstituted dairy products to achieve unprecedented spatial and temporal resolutions, under given conditions. Stimulated Emission Depletion (STED) microscopy has been used to image dairy gels from fresh and reconstituted skim milks. Protein structures have been resolved to 100 nm after an imaging protocol that does not require sample preparation except for fluorophore addition. Quantitative image analysis has been developed using an empirically validated model to extract the size of protein domains, pore size, fractal dimension and degree of co-localisation of two distinct components. This image correlation-based analysis method has many potential applications to quantifying different porous, fractal or multi-component system. Coherent Anti-Stokes Raman Scattering (CARS) microscopy provides a label free negative control for the use of a fluorescent dye required for STED imaging. The speed of sound and acoustic attenuation is dependent on a material’s physical properties. Consequently, information can be obtained about the dynamic changes in the sample. Ultrasound Reflection Spectroscopy has been used to monitor the changes in the dissolutions of dairy derived powders. The frequency dependent attenuation spectrum provides unique measurements on concentrated colloidal dispersions without dilution. Effective combination of these techniques provides a unique insight into the entire process of characterizing a reconstituted dairy derived gel with novel temporal and spatial resolutions.