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Femtosecond Stimulated Raman Microscopy: A Novel Method for studying Liquid-Liquid Phase Separation

Liquid-liquid phase separation (LLPS) phenomena play a central role in the formation of membranelles organelles in cells [1] and in the synthesis of stiff proteinaceous biomaterials [2]. Liquid–liquid phase separation of macromolecules is referred to as coacervationion and it is proposed that complex coacervates played an important role in the origin of life [3]. In the last decade, the interest in synthetic coacervates grew for its application in complex encapsulation of, for example, proteins [4]. Two major challenges need to be met when studying phase-separation processes: (i) The quantity of material required and (ii) the need to use multiple complex measurement techniques. Raman microscopy is a powerful technique that can overcome these difficulties, but until today only a few studies used Raman techniques to investigate the coacervation phenomena.
We use femtosecond stimulated Raman microscopy (FSRM) as a novel method to investigate LLPS. FSRM is a non-linear imaging technique able to achieve full spectral coverage for each pixel with an acquisition time as fast as 0.1 ms and was already successfully applied to polymer characterization. [5,6] First FSRM results on polymeric coacervates, formed by the polyelectrolytes Poly(sodium styrene sulfonate) (PSSS) and Poly(diallyldimethylammonium chloride) (PDADMAC), will be presented.

References

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Figures

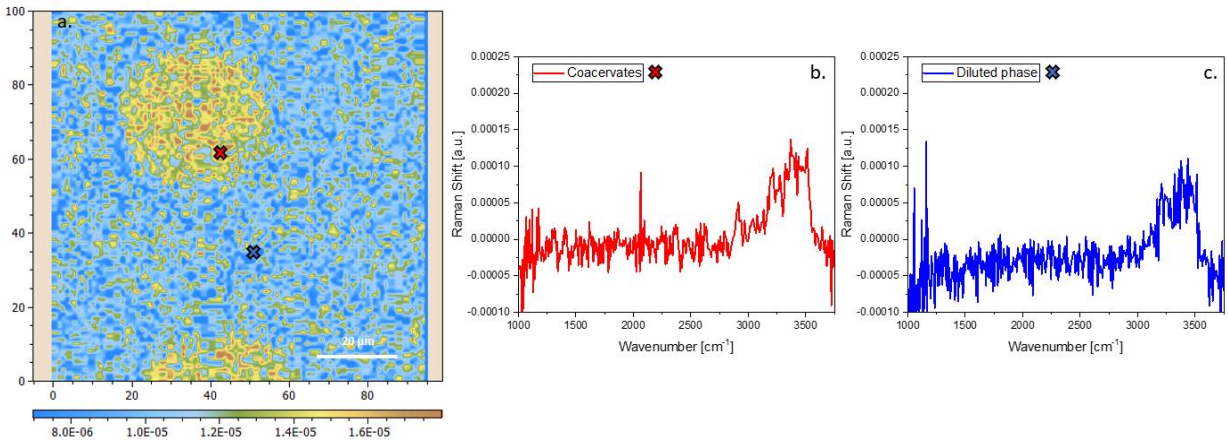

Figure 1: (a.) FSRM chemical map of a PSSS/PDADMAC coacervate in water. It has100x95 pixels with a resolution of 1 µm, and was recorded in ~ 25 min. The map is colour-coded for the intensity of the polymer C-H stretch peak. (b) Raman spectrum from the map coacervate region and (c) Raman spectrum from the map diluted phase region.