Raman- and partial molar Raman spectroscopy for the detection of nanostructured systems

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Abstract

We show that at pressures from 10 MPa up to 22 MPa and temperatures around 308 K the ternary mixture composed of water, CO_2 and acetonitrile forms a transparent single-phase mixture from a thermodynamic point of view, but features nanostructuration in water-concentrated and water-depleted domains on a sub-micro-scale. The structuration does not require any surfactant as Hankel et al. showed in the ternary system acetone/CO_2/water. [1] In contrast to conventional microemulsions the surfactant-free CO_2-based nanostructured systems are pressure sensitive and therefore their structuration can be switched "ON" and "OFF" by pressure variations. This opens a door to new and green strategies in process technology. [2]
The detection of nanostructuration is based on Raman spectroscopy and the analysis of the OH-stretching vibration.
Furthermore, we use *partial* molar Raman spectra for the detection of nanostructures in the three binary mixtures acetone/water, n-propanol/water and tert-butanol/water where in two of the mixtures both components contain an OH-bond. We use *partial* molar spectra to separate the OH-stretching vibration signals emerging from either water or the solvent.
The poster will demonstrate the application of Raman spectroscopy in microcapillaries that makes possible the fast and reliable screening of potentially nanostructured systems.

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References

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