ELECTRONIC SUPPLEMENTARY INFORMATION

Whirl-enhanced continuous wave laser trapping of particles

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SIM1 – Laser assisted liquid-liquid phase separation

A short video illustrates the formation of enriched in para-nitroaniline solution by action of 405 nm laser light on the free liquid film of para-nitroaniline dissolved in 1,4-dioxane on a glass plate. Movie is taken by CCD camera under optical microscope. We can see how a rapid movement of the laser spot outside the color droplet leaves it alone and a small new one is formed in the place of the beam center (which is invisible). The previously formed droplet starts to behave chaotically and disappears in a diffusive manner in the solvent within seconds. If the new para-nitroaniline collection center (i.e. laser spot) is close to the previous one we see the sucking of the colored (saturated) solution. In result much faster growth in size of the new droplet is observed. Interestingly the p-NA is attracted from the distances much larger than the light spot size.

SIM2 – Laser "tornado"

A short video illustrates the whirl produced in oversaturated and containing microcrystals solution of para-nitroaniline in 1,4-dioxane. Layer of the solution is covered by a microscope glass and illuminated form the bottom by lightly focused laser beam of 405 nm wavelength. The whirl – vigorous movement of liquid is here stabilized by trapped gas bubble – which is seen as a dark circle empty in the center (diameter 50 microns). With moving the laser beam the whirl and bubble are moving through the system. The energy stored in this whirl is remarkably high allowing for movement of micrometric size crystals and their rapid dissolution. The strength of this whirl is similar to that observed on the Earth tornados if one takes into account the proper scale of these two events.

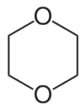
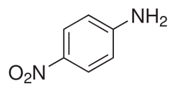
SIM3 – Laser controlled crystal growth

A short video illustrates how the laser beam works in para-nitroaniline solution, enrich the concentration of solute and step-by-step feeds the crystal seed with the substance resulting in its growth.

SIM4 – Ejection of matter form a whirl

A short video illustrates the collection of para-nitroaniline from solution by action of whirl produced by a laser beam. The whirl is entrapped in the gas bubble. When rich in para-nitroaniline droplet size reach that of the radius of the bubble the matter cannot be further trapped and is vigorously ejected outside. This process is repetitive.

Table 1S. Physicochemical properties of solvent (1,4-dioxane) and solute (p-nitroaniline)

	1,4-dioxane, liquid at 295 K	p-nitroaniline, solid at 295 K
Molecular formula	$C_4H_8O_2$ 	$C_6H_6N_2O_2$ 
Molar mass	88.11 g mol^{-1}	138.124 g mol^{-1}
Density	1.033 g/mL	1.333 g/cm^3
Melting point	11.8 °C (284.9 K)	146-149 °C
Boiling point	101.1 °C (374.2 K)	359.6 °C / 760 mmHg
Surface tension	31.2 ± 3.0 dyne/cm	60.3 ± 3.0 dyne/cm
Viscosity	1.177 mPa s (at 25 °C) 0.787 (at 50 °C)	-
Specific heat capacity	1.721 J/gK (151.6 J/mol K)	1.116 J/gK (154.2 J/mol K)
Thermal diffusivity	9.063 x 10^{-6} m^2/s	
Thermal conductivity	0.159 W/mK at 25 °C and 0.147 at 50 °C	
Molar refractivity	21.65 ± 0.3 cm^3	37.0 ± 0.3 cm^3
Polarizability	8.58 ± 0.5 10^{-24}cm^3	14.68 ± 0.5 10^{-24} cm^3
Index of refraction	1.404 (at 589 nm)	1.634 (at 589 nm)
Dielectric permittivity	2.2189	
Permanent dipole moment	0.05 D	7.73 D (DFT method)* 6.87 D (experiment)*

*) J. Chem. Phys., 123, 074307, (2005)