Raman spectra studies on droplets containing medicines

Mihai Boni, V. Nastasa, A. Pascu, Angela Staicu and M. L. Pascu

National Institute for Laser, Plasma and Radiation Physics, Bucharest, Romania

The paper reports results regarding Raman spectra measurements we performed on (micro-) droplets of ultra-pure water and DMSO. The ultra-pure water and the dimethyl sulfoxide (DMSO) are some of the most utilised solvents of medicines in basic and clinical studies. To understand the interaction of the drugs with different targets of theirs it is necessary to understand the behaviour of solvents in the conditions in which the drugs are used.

The Raman spectra were recorded using a computer controlled system (SpectraPro - 2750 monochromator coupled with a Princeton Instruments PI-MAX Intensified CDD camera).

The water and, respectively, DMSO droplets were exposed to a pulsed, Nd:YAG laser radiation (pulse time width 6 ns, λ=355 nm λ=532 nm, laser pulses repetition rate 10 pps). The beam was focused into the droplet's volume so that the diameter at the focus place was 2 mm and the peak power energy density in the focus was (around) 3.18 W/cm^2.

The droplets were generated using a computer controlled capillary system (Hamilton - Microlab 500). The diameter of the generated droplets was in our experiments 3 mm; the droplet was produced using a calibrated capillary which had the internal/external diameter ratio 1.19 mm/1.65 mm. The liquid volume pumped to obtain the droplet, under computer control, was typically 12.5 μl.

The temperature of the droplets was monitored with the thermo-camera ThermaCAM® E45. The results have shown that the substances that do not absorb at λ=355 nm λ=532nm and those which do not emit fluorescence have no major changes in temperature (less than 1°C, which may be correlated with the temperature variations in the room). The fluorescent substances (typically Rhodamine 6G) show an increase in temperature during irradiation which was 10-12 K. Water, as well as DMSO, do not absorb at 355 nm and 532 nm, so that following the interaction with the laser radiation the temperature increased with at most 1°C.

The Raman spectra of DMSO and water were measured in two cases: bulk and droplets. In this paper the Raman spectra obtained from droplets were measured and a comparison was made with the spectra measured on bulk samples. The DMSO Raman spectrum for droplets excited at 355 nm and 532 nm is Raman spectra of DMSO and water obtained from droplets samples are in agreement with literature reports; the temperature of DMSO and water droplets, changes insignificantly during the exposure to laser radiation.