3D spatial control and the spatial generation of stimulated Raman scattering in ethanol

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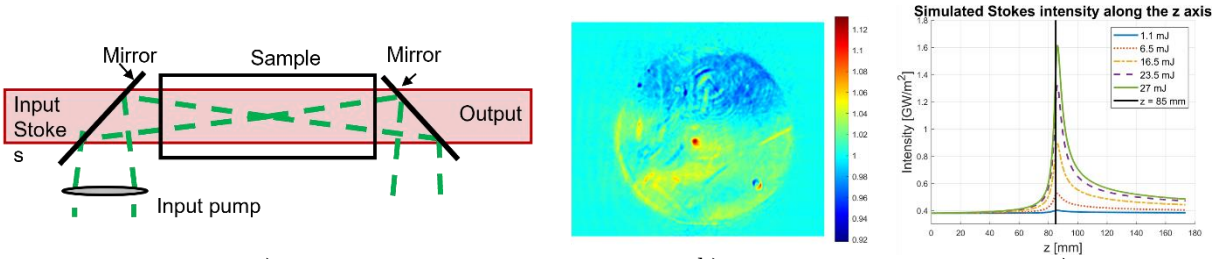
KEY WORDS: SRS, imaging

Stimulated Raman scattering[1] (SRS) has been used for imaging of specific species in areas such as medicine and biology[2-3]. SRS allows for the imaging of a selected molecular vibration ω_m by illuminating the sample with a pump laser beam and a Stokes laser beam whose frequencies fulfills the condition $\omega_m = \omega_P - \omega_S$. In order to provide 3D species specific images of a sample without the need for point scanning the sample knowledge about the spatial generation and the spatial control of the SRS signal is required. The principle of the sample setup, see Figure 1 a), a collimated Stokes beam passes through the sample meanwhile the pump beam is focused into the sample.

For the 3D spatial control of the SRS signal a phase spatial light modulator (SLM) was used to control the position and shape of the pump beam focus. The investigation of the spatial generation was done by computer simulations and experiments. The simulations were based on diffraction theory[4] for the beam propagation and a phase modulation due to the induced Kerr effect[5] for the change in SRS signal. The simulations where run for different energies of the pump beam and compared to experimental results.

In Figure 1 b) the SRS signal, red spot near the center, that has been shaped using a SLM can be seen. The spatial generation of SRS was investigated via computer simulations and experiment. In Figure 1 c) the generation of SRS along the propagation axis for 5 different pump energies can be seen.



a) b) c)

Figure 1: a) The principle of the SRS imaging system. Collimated stokes light is passed through the sample meanwhile the pump beam is focused into the sample, b) the spatially shaped SRS signal (red dot near the center), c) SRS signal along the propagation axis for different pump energies.

The results shows that 3D control of the position of the generated SRS signal can be controlled using a SLM and that most of the signal is generated close to the focal point of the pump beam focus.

We would like to thank the Swedish Foundation for Strategic Research (ITM17-0056) for financing this project.

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