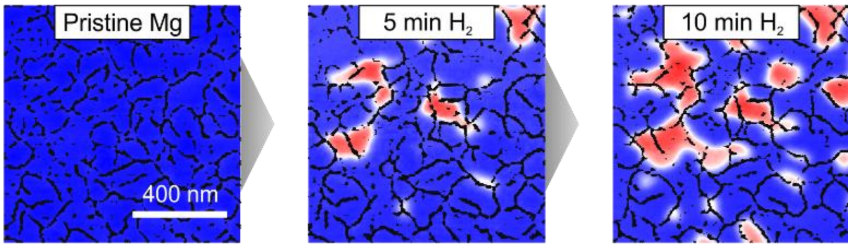
BSc/MSc Thesis in Experimental Physics

4th Physics Institute

Nanooptics on switchable plasmonic materials in the mid-infrared spectral region

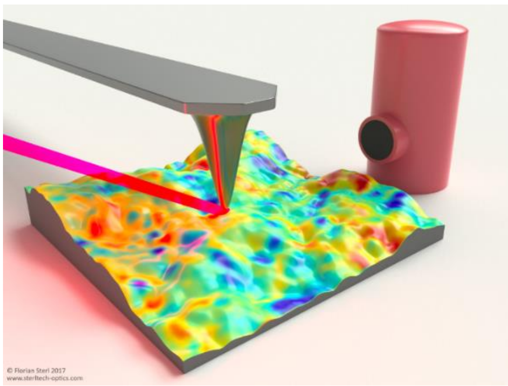
Magnesium is an energy storage medium of the future, as it can incorporate hydrogen and form MgH_2. The process of microscopic hydrogen diffusion, transport, and incorporation is still not fully understood.

In order to study this process to create better and faster energy storage materials (both protons for charges as well as hydrogen for a carbon-free fuel economy), we are using scattering SNOM (scanning near-field optical microscopy) to reveal the different areas with hydrogen filling inside of the Mg.



An ultrafast laser is tuned to the MgH_2 phonon resonance around 1300 cm^{-1}, giving excellent nanoscopic imaging contrast.

In this thesis, we would like to explore the effect of patterning the catalytic palladium material which splits the H_2 molecules into protons. Diffusion near the grain-boundaries is believed to be much faster than in the bulk. If confirmed, nanostructured catalytic layers could enhance energy storage and recovery in magnesium in the future.



The student should be interested in optics and materials science. Tasks of this thesis include lab work in the nanostructure lab, as well as working with ultrafast lasers and nanooptics.

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Literature:

F. Sterl et al., Nano Letters **18**, 4293-4302 (2018).
J. Karst et al., Science Advances **6**, eaaz0566 (2020).