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Functionalization of molecular ensembles

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At UBONN we have used nanofibers produced at JOGU Mainz to perform optical switching of organic molecules and have thus demonstrated a first functionalization of molecules on optical nanostructures.

Photochromic molecules can be switched by irradiation with light between two forms having different absorbance spectra. Typically only one form absorbs light in the visible wavelength range and is therefore called the colored form, the other form is called transparent, and both forms absorb light in the UV wavelength range. Switching from the transparent to the colored form occurs by illumination with UV light, the back switching from colored to transparent by illumination with white light.

At UBONN we have deposited a spiropyrane and a diarylethene photochromic molecule on our optical nanofibers. We have detected the two conformational states of these molecules via white-light ultra-sensitive surface absorption spectroscopy. The molecules were switched on the timescales of seconds using very low powers (nanowatts) of white light and UV light guided by the nanofiber.

A detailed analysis of time-resolved measurements of the switching process together with a rate equation model has allowed us to determine the fraction of switched molecules to be >90%. We have also characterized the durability of our photochromic system under repeated switching, the so called cyclability. The spiropyrane molecules could be switched about 40 times until severe photodestruction due to the UV exposure was observed. By determining the ratio between photoswitching and photodestruction sensitivities, an upper limit of the intrinsic molecular "ideal cyclability" on the order of 400 switching events could be deduced.

For details please see the attached report.