

The present performance of our system in terms of cyclability and switching speed is not limited by the properties of the individual molecules. Experiments with photochromic molecules in solution show much higher cyclabilities. The fatigue resistance in our experiments can be enhanced by changing the environment such as excluding oxygen by placing the OMFs in a noble gas atmosphere or protecting the molecules by a polymer matrix. State-controlled deposition could increase the number of molecules participating in the switching process. The switching speed can be increased by orders of magnitude by applying tailored laser pulses. Since the switching process of diarylethene molecules themselves occurs on a picosecond timescale (in solution) [22], we expect the dynamics of adsorbed molecules to be governed by a similar time scale. A further improvement of the experimental results can be achieved by reducing the light-molecule coupling inhomogeneities, e.g. at the taper sections.

For characterization and comparison of switchable molecules it would be very useful to define an intrinsic cyclability of the molecules, independent of the optical system. This “ideal cyclability” would specify how often on average a single molecule could be switched before it undergoes a destructive side reaction. As the photodestruction is only caused by the UV light, the critical switching step is the photocolouration. An upper limit to the ideal cyclability can thus be obtained by measuring the ratio of the UV-induced photocolouration and photodestruction quantum yields of the transparent molecules ($Z_{50,ideal} = \Phi_{photocol} / \Phi_{destr,tr}$). To measure $\Phi_{destr,tr}$ instead of $\Phi_{destr,col}$ the measurement in Sec. 4.2 can be modified such that most molecules stay in the transparent state by using e.g. reduced UV power.

Acknowledgments

Financial support by the EC (STREP “CHIMONO”) and the DFG (Research Unit 557) is gratefully acknowledged. We would also like to thank C. Dan for his contribution in the early stages of the experiments and R. Herges, K. Meerholz, and E. Maibach for valuable discussions.