Giant photomechanical Stress from Orientation of Azobenzenes

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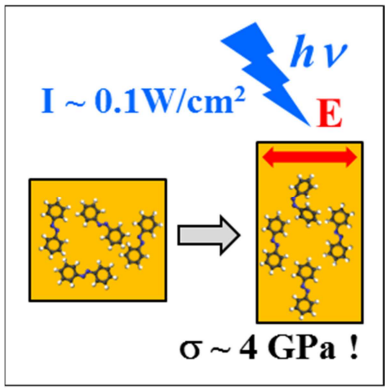
To make a polymer-based material photosensitive, it is usually modified by inclusion of azobenzene chromophores. Their reaction to the light via photoisomerisation leads to conversion of absorbed energy into mechanical work. In many cases, the light-induced deformation occurs below the glass-transition temperature of the polymer. This glassy state remains nearly unaffected under illumination [1]. Recent experiments show that light-induced stress can reach a giant value of 2 GPa and is able to break the metallic layer on the surface of a glassy azo-polymer as well as to deform covalent bonds [2-3].



I will present an explanation for the photomechanical stress of such a giant magnitude. Starting from kinetic equations of photoisomerization, we show in [4] that the light acts as the effective potential, which reorients chromophores perpendicularly to the polarization direction. The strength of the potential is defined by optical and viscous characteristics of the material. The potential can generate the stress up to 4 GPa, in accordance with recent experimental findings for azobenzene materials deep in a glassy state [2-3]. Whether a sample expands or contracts along the polarization vector is defined by the chemical structure of the material.

[1] V. Toshchevikov and M. Saphiannikova. *J. Soc. Inf. Disp.* **23** (2015) 146
[2] N.S. Yadavalli et al. *ACS Appl. Mater. Interfaces* **5** (2013) 7743
[3] G. Di Florio et al. *Nano Lett.* **14** (2014) 5754
[4] V. Toshchevikov et al. *J. Phys. Chem. Lett*. **8** (2017) 1094; *Soft Matter* **13** (2017) 2823