Photo-isomerization of organic molecules anchored on silicon surfaces

Most materials are used due to their structural and functional properties, e.g. aluminum as good heat conductor, copper or gold as current conductor, etc. Intelligent materials on the other hand can change their properties due to external stimuli. If a material changes its properties due to light it is considered as photo-active.

Some molecules for example can change their geometry due the absorption of light, e.g. one bond can be created or destroyed or the part of the molecule is rotated at a double bond (figure 1 left). If these molecules are attached on a surface, the properties of the surface can be changed by switching the molecules from one form to the other. This can be used for different applications. For example, the surface can be switched to a more or less hydrophilic state which is interesting for microfluidics [1]. The control of the conductivity could be used for organic electronics [2], or generally intelligent coatings could use the different properties of the different states.

In my work this is realized by anchoring Fulgimide on organic monolayers, as one can see in figure 1 (right).

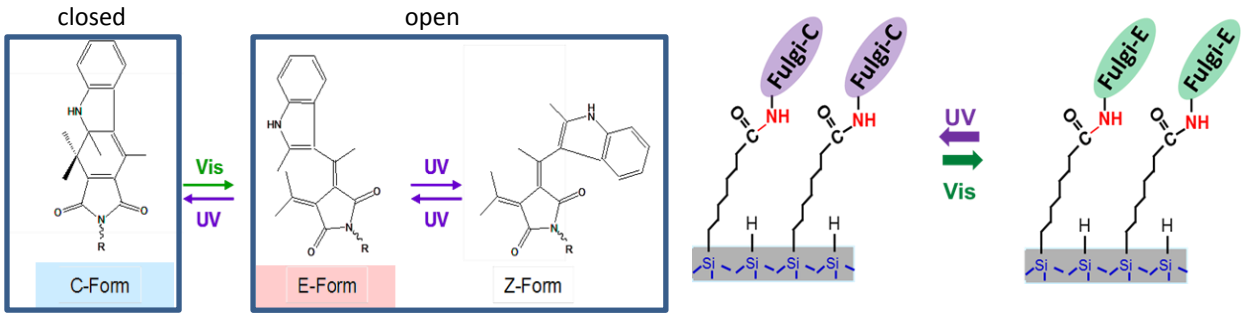

Figure 1: left: three different forms of the fulgimide; right: Fulgimide anchored on organic monolayers

These surfaces can be switched by UV or visible light from one state to the other. In figure 2 several commutations of the organic thin film are shown. The photo commutation works reversibly and can be qualitatively described. The commutation speed can be controlled by the light flux and is of the order of one minute. Corresponding cross sections can be determined and qualitatively understood by considering the local electric field of the light in different environments.

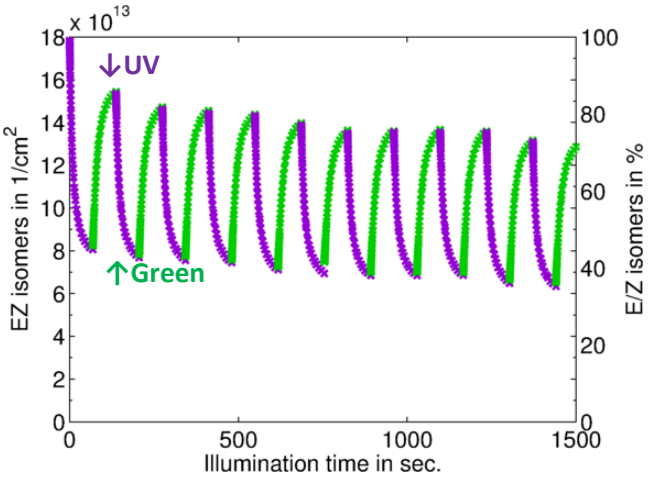

Figure 2: Several commutation cycles of fulgimide anchored on silicon surfaces. The number of molecules in E/Z form decreases due to UV illumination and subsequently increases due to green illumination

In the next month I will study how the density of the molecules on the surface and the temperature influence the commutation. Furthermore, I will add gold nanoparticle on top of the organic layer to increase the local electric field and thereby receive a quicker commutation.

[1] X. Pei et al.*Langmuir*, 2011, 27 (15), pp 9403–9412
[2]K. Uchidaet al.*J. Am. Chem. Soc.*, 2011, 133 (24), pp 9239–9241

Stefan Klaes