Triggering molecular processes with light

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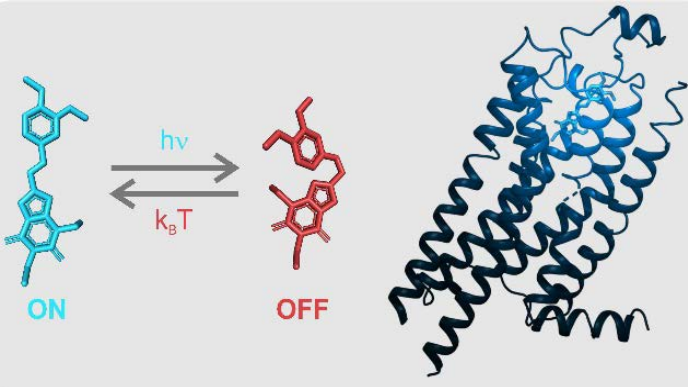
Molecular systems that can be remotely controlled by light are gaining increasing importance in biosciences. High spatial and temporal precision is achievable with short laser pulses via three main approaches for light regulation. **Chromoproteins** with built in photoswitches like rhodopsins can be directly photoactivated.[1] In the field of optogenetics, genetically encoded light sensitive proteins such as channelrhodopsins[2] enable the control of single neurons. Alternatively, **photolabile protecting groups** can be used to irreversibly trigger processes (uncaging) or **photoswitches** for reversible switching. My talk will focus on our recent progress in these fields.

Molecular photoswitches are highly selective, non-invasive tools for light control of nanosystems. Azobenzenes (ABs) are an important class of photoswitches with photochromism based on the E ↔ Z isomerization of their N=N bond. When suitably linked to biomolecules, azobenzene can serve as light trigger for initiating conformational transitions. The introduction of photoswitches into peptides, nucleic acid constructs, and proteins enables photocontrol of the function of such biomacromolecules and the reprogramming of their response.[3] ABs have also been implemented in complex nanostructures and materials to introduce photoresponse. Furthermore, studies on the ultrafast isomerization dynamics of substituted and multichromophoric systems[4,5] (bis- and tris-ABs) provide a deeper understanding of the photophysics and photochemistry of the individual building blocks and open the way to an intelligent design of complex photoswitchable nanostructures with suitable connectivity patterns in crowded environments. Together with serial crystallography and quantum chemical simulations we could recently observe the ultrafast structural transformations of azobenzene-based ligands within the tubulin and the A_{2A} receptor binding sites. Time-resolved snapshots reveal molecular details of ligand-protein interactions and the release of a photoactivated compound from its pharmacological target.[3,4,6]



References

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