Molecular Motors and Switches at Surfaces

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Nano-engines and molecular motors form the basis of nearly every important biological process. In contrast to this solution chosen by Nature for achieving complex tasks, all of mankind's present day technologies function exclusively through their static or equilibrium properties. One can therefore easily anticipate that the controlled movement of molecules or parts of molecules offers unprecedented technological possibilities for the future. In this presentation I shall illustrate how introducing new concepts like incorporating a ratchet mechanism, allows for the creation of molecular engines that transcend simple switches. I shall discuss how to build molecular engines that allow movements at the molecular level to be coupled to the macroscopic world, e.g., to store information in polymer films, or to transport macroscopic objects like drops of liquid over a surface.

Another example are molecular systems that can be triggered to form spontaneously functional structures with a well-defined position on surfaces. I shall explain this idea for "nanomills", the nanoworld counterpart of windmills, namely molecular motors where repetitive unidirectional rotation around the central double bond is achieved.

Finally, I shall discuss molecular switches which can be addressed with light and charge transfer and show that such systems can be employed for “read and write” functions.