Molecular Motors embedded in Nanoporous Frameworks

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How can we control the movement of individual molecules in a temporal and spatial domain and coordinate their motion and interactions to generate something like a "molecular clockwork"? We address this questions by establishing self-assemblies of responsive dynamic molecules such as molecular motors and switches into solid state hybrid framework materials such as metal-organic frameworks (MOFs) or covalent organic frameworks (COFs). We study these solids with respect to local, global and collective dynamics and explore the effect of framework dynamics on dynamic host-guest interactions in nanopores. In a computational approach we demonstrated how such "motorized pores" can facilitate directed and activated transport and what design criteria have to be addressed for real world systems. In this contribution I will detail how we can incorporate molecular motors as light-responsive molecular building-blocks with controllable rotational dynamics into the backbone of MOFs and COFs and compare the motor dynamics in solution and in the frameworks.

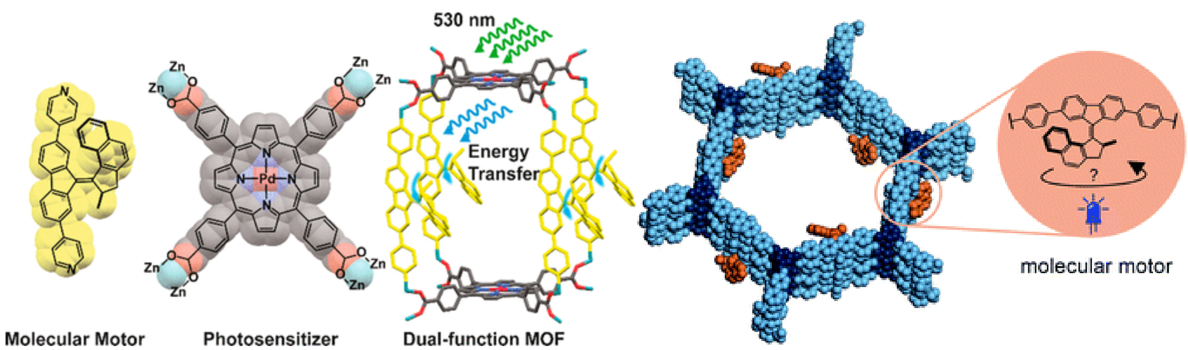

Figure 1. Molecular Motor in a bifunctional MOF (left) and in a COF made of 2D sheets (right)

I will show how we can use a secondary porphyrin linker incorporated in the MOF to drive the molecular motors at red-shifted excitation wavelengths. From these studies a series of challenges arose, in particular with respect to experimental analysis of motors in the solid state at low concentrations which will be discussed. We believe that these findings build an exciting foundation to further extend research into framework-embedded molecular motors or machines in general.

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