Fluorescent nano-switches based on stimuli-responsive supramolecular interactions

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Tuning fluorescence reversibly and in a single nanostructure is of great interest for different applications from bioanalytic nanoprobes to sensors and photo-electronic devices. We propose to use stimuli-responsive supramolecular interactions to design dynamic plasmonic systems allowing one to tune reversibly the nanoparticle/fluorophore distance and thereby the resulting fluorescence (Fig. 1). Our recent results obtained with gold nanoparticles linked with fluorophores through thermoresponsive poly(N-isopropylacrylamide) polymer provide the proof for the proposed approach [1]. We are now extending it to oligo(ethylene glycol) copolymers having tunable transition temperature [2], aiming to produce multifunctional bioanalytical nano-probes, combining the possibility of local heating with nano-scale temperature sensing. In parallel, we develop fluorescence switches based on redox-driven host/guest interactions such as between β-cyclodextrin and its guest ferrocene. Our previous studies on surfaces showed that several levels of control are achievable with host/guest chemistry, including strong binding at high selectivity thanks to multivalency, combined with reversibility under external stimuli [3]. Our goal is to extend this strategy from surfaces to nanostructures by developing redox- or photo-sensitive nano- switches suitable for fluorescence sensing assays in solutions and on surfaces.

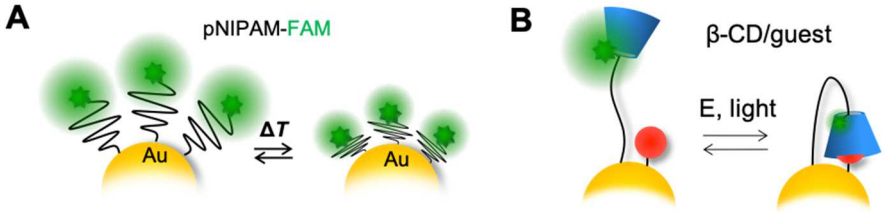

Fig. 1. Fluorescence nano-switches based on thermo-responsive pNIPAM (A) and host/guest interactions sensitive to electrochemical stimuli or light (B).

[1] D. Kamzabek et al, Langmuir, 37, 10971–10978 (2021)
[2] J. Jing et al, J. Mater. Chem. B, 1, 3883–3887 (2013); M. Rippe et al, Biomater. Sci., 7, 2850–2860 (2019)
[3] G. Dubacheva et al., Chem. Commun., 47, 3565-3567 (2011); G. Dubacheva et al., Proc. Natl. Acad. Sci. USA, 112, 5579-5584 (2015)