

## Dual stimuli-responsive self-assembled supramolecular nanoparticles

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Supramolecular nanoparticles (SNPs) are built by multiple copies of different building blocks assembled by specific non-covalent interactions. These assemblies are of interest because of their high potential for biomedical applications. In order to tune the properties of these biomedical delivery vehicles, their assembly and disassembly need to be controlled, for example to define their size and equip the SNPs with controlled release properties. The present study discusses the fabrication of dual responsive SNPs using the molecular recognition of mono- and multivalent building blocks equipped with the photoswitchable azobenzene (Azo) and poly(ethylene imine) functionalized with methylviologen (MV) in the presence of cucurbit[8]uril (CB[8]). Azo and MV form a charge transfer complex that is stabilized by inclusion in CB[8], constituting a ternary complex. Mixing of the multivalent and monovalent building blocks in different ratios while maintaining a stoichiometric ratio between Azo, MV and CB[8], provides a way to tune the particle size, while the light (Azo) and redox (MV) switching properties offer a way to affect the ternary complex and thus control the assembly and disassembly of the complete supramolecular nanoparticle architecture.

DLS and SEM analysis confirm the size control of the particles by tuning the ratio of the multivalent vs. monovalent Azo-derivatives, while keeping the overall concentrations of the molecular recognition moieties equimolar. Irreversible particle destruction is observed after reducing the MV species chemically. In contrast, reversible particle disassembly and re-assembly is shown upon trans-cis and cis-trans isomerization of the Azo groups, respectively. Remarkably, the particle disintegration is relatively slow in comparison to the disruption of the ternary complex, which is attributed to an interplay of multivalent interactions acting in the core of the SNPs. This study presents a supramolecular AND logic gate; SNPs are only formed with Azo moieties in the trans state and the MV in its oxidized form.