Fluorescent organic nanoparticles for biosensing

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Fluorescent organic nanoparticles (NPs) emerged as an attractive platform for designing functional nanomaterials, including fluorescent biosensors. Particularly promising are dye-loaded polymer[1] and lipid[2] NPs, inspired from the field of drug delivery.

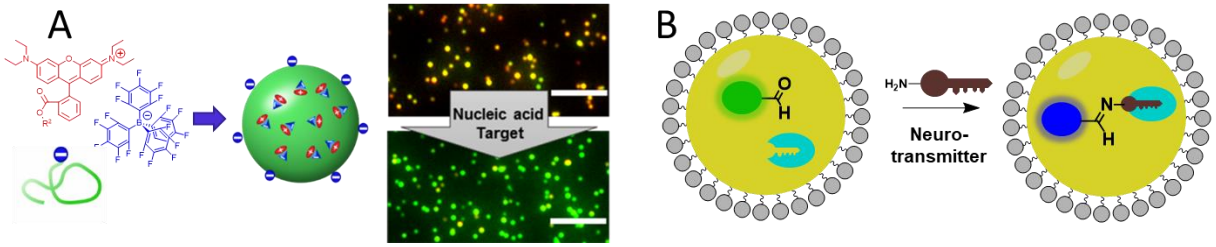

Figure 1. Design of polymer (A) and lipid (B) NPs for biosensing.

To assemble polymeric NPs of controlled size of 10-40 nm, we developed an approach of nanoprecipitation of hydrophobic polymers bearing a few charged groups.[3] To ensure dye encapsulation with minimal aggregation-caused quenching, bulky hydrophobic counterions were proposed as nano-spacers within dyes.[4] Close dye proximity with minimal aggregation ensured ultrafast dye-dye energy migration rendering NPs unprecedented light-harvesting properties[5] and enabled long-range energy transfer breaking the Forster law.[6] Their functionalization with DNA yielded nanoprobes for amplified detection of RNA/DNA markers (Fig. 1A) of cancer[7] and viral diseases.[8]

In the second approach, we developed fluorescent lipid NPs,[2] which are self-assembled from reagents generally recognized as safe. Their good stability in vivo[9] suggested them as promising nanocarrier of contrast agents and drugs as well as nanoreactor for biosensing. By combining molecular recognition with dynamic imine chemistry inside this lipid nanoreactor, we introduced a concept of artificial receptor for neurotransmitter sensing.[10] Further coupling of molecular recognition with an irreversible reaction inside the nanoreactor enabled us to reach nM sensitivity to the neurotransmitter target.[11]

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