A near-infrared and temperature-responsive nanoreactor based on core-shell polydopamine@PNIPAm microgel

Xiaohui[1,2], Bo Bai[2], Matthias Ballauff[1], and Yan Lu[1]

[1] *Soft Matter and Functional Materials, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Berlin, Germany*
[2] *College of Environmental Science and Engineering, Chang'an University, Xi'an, P. R. China*

Controlled stimuli-responsive release systems are a feasible and effective way to increase the efficiency of pesticides and help improve environmental pollution issues. However, near-infrared (NIR)-responsive systems for controlling release have not been reported because of high cost of conventional NIR absorbers (gold nanorods) and complicated preparation process [1]. A significant strategy has been developed to utilize polydopamine (PDA) microspheres as a new class of photothermal agent owing to their abundant active sites, satisfactory photothermal efficiency, low cost, and easy fabrication.

In this study, we devised an NIR light and temperature remote-triggered pesticide delivery system based on the photothermal PDA dispersed in cross-linked poly(N-isopropylacrylamide) (PNIPAm) matrix, applied as both a thermosensitive gatekeeper and a pesticide reservoir [2]. Such design combines synergistically photothermal properties and thermoresponsive properties in a single nanoplatform; the PDA embedded inside the PNIPAm matrix could serve as an antenna to absorb the light and convert it to heat, which will induce shrinkage of the PNIPAm matrix and facilitate the release imidacloprid (IMI), from the interior of polymer matrix. The application of PDA microspheres embedding immobilized approach is advantageous compared to other photothermal nanoparticles such as gold nanoparticles owing to easy fabrication and scale-up, low cost, and high loading, since the introduced PDA microspheres not only exhibit strong photothermal effect but also provide additional active surface for IMI immobilization. In our future plan, we try to immobilize metal nanocatalysts onto thermosensitive core-shell microgels to solve aggregation problem of nanometer-sized metal nanoparticles. More interestingly, the catalytic activity of metal nanocatalysts can be controlled by the volume transition of thermosensitive shells [3]. The Au interspersed PDA@PNIPAm nanoreactor hold great promise for many smart nanomaterials, such as photothermal therapy, intelligent drug carrier, magnetic separation, and tunable catalysis.

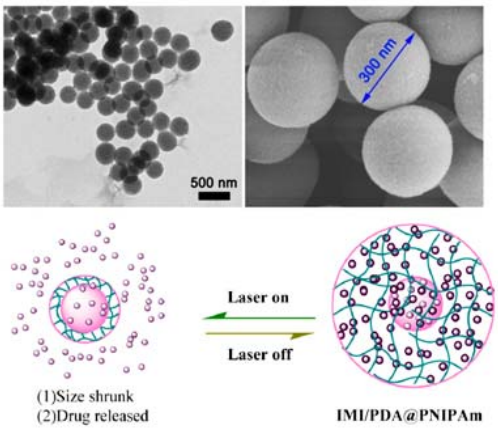

Figure 1. NIR light remote-triggered pesticide delivery of core–shell PDA@PNIPAm microgel.

[1] Y Wang, et al. *ACS Nano.* **7** (2013), 2068.
[2] X Xu, et al. *ACS Appl. Mater. Interfaces.* **9** (2017), 6424.
[3] S Wu, et al. *Angew. Chem. Int. Ed.* **51** (2012), 2229.