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Nanoparticle assembly with customisable fluorescence properties and excellent biocompatibility†

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This article highlights the recent work by Wang, Qi, *et al.* (*Nanoscale Horiz.*, 2024, **https://doi.org/10.1039/D4NH00400K**) on the full-color peptide-based fluorescent nanomaterials assembled under the control of amino acid doping.

Fluorescent reporters are invaluable tools for biomedical research like cell imaging, sensing or tracking analysis. In particular, the fluorescence labelling of nanomaterials remains a critical step in the development and evaluation of candidate nanomedicines. As commercial fluorophores are rather costly and fixed to a single emission, alternative strategies to produce labelled nanomaterials with tunable emission colour are highly coveted.

In a recent paper (**https://doi.org/10.1039/D4NH00400K**), Wang, Qi, *et al.* reported the versatile assembly of organic nanoparticles with adjustable emission wavelength using the enzymatic oxidation of the protected amino acid *N*-(*tert*-butoxycarbonyl)-L-tyrosine (Fig. 1). The biocatalytic oxidation of this amino acid induces its polymerisation into a variety of condensation products, which can co-assemble with unprotected amino acids added post-polymerisation to generate nanoparticles ranging from 5 to 10 nm in diameter. Interestingly, depending on the amino acid fed post-polymerisation, the fluorescence spectra of the afforded nanoparticles could be shifted across the whole visible range. The fluorescence of these nanoparticles stems from the aggregation-induced emission of their constituent amino acids, with different restrictions in bond rotation – and hence emission colour – for each nanoparticle formulation. Indeed, molecular dynamics simulations supported the aggregation mechanism and fixation of bond rotation, which together explain the assembly of these emissive nanoparticles.

The authors also demonstrated the excellent biocompatibility of these nanostructures *in vitro* and tracked their uptake by HeLa cells using confocal laser scanning microscopy. These results prove the great potential of this versatile technology to produce nanoparticles for biomedicine with tailored fluorescence from biomolecular precursors.

Overall, this paper lays down the basis for a new nanoparticle assembly platform with customisable fluorescence and excellent biocompatibility. The simplicity and modularity of this approach can make a strong impact on fluorescent nanotechnology, especially in the areas of drug delivery and cell traffic analysis, with broad application in the wider field of biomedicine.

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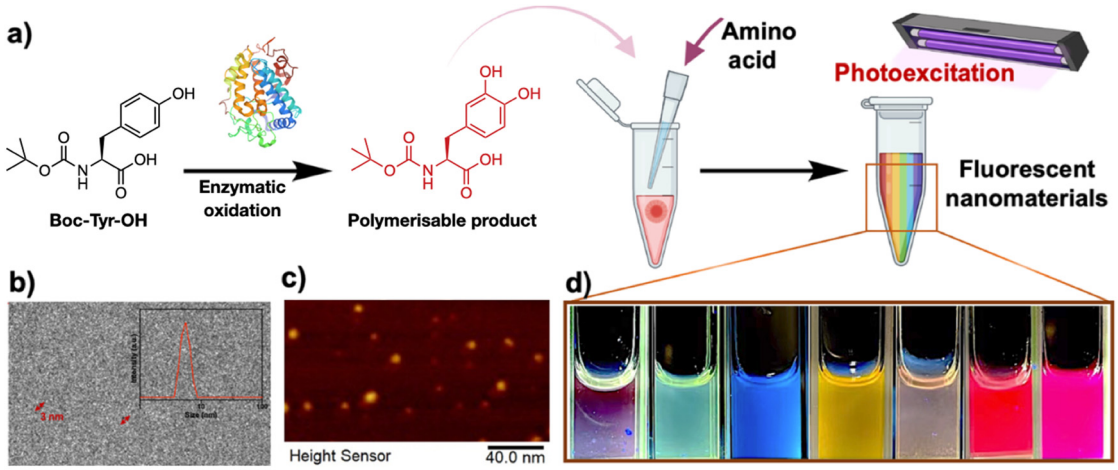

Fig. 1 (a) Nanoparticle preparation scheme: sequential enzymatic oxidation of Boc-Try-OH into a reactive product that generates polymers, which can be doped with free amino acids to form fluorescent nanoparticles. (b) Cryo-TEM and (c) AFM images of the afforded nanoparticles. (d) Visible emission of different nanoparticle formulations irradiated at 365 nm. Adapted from **https://doi.org/10.1039/d4nh00400k** with permission from the Royal Society of Chemistry.