Novel, Highly Luminescent Nanographene as pH- and Metal-Sensitive Fluorophore for Optical Imaging

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Fluorescent probes that respond to pH and/or metal ions are used in many applications, including biological research and environmental monitoring. The development of optical super-resolution nanoscale imaging and detection techniques, going beyond the diffraction limit of conventional light microscopy, have further enhanced the potential of fluorescence sensing in recent years. However, the existing pH and/or metal-ion sensitive fluorophores, especially for the super-resolution imaging[1], are limited by low photo-stability and narrow dynamic pH ranges, making it challenging to detect, for instance, modest changes in pH.

Here, we report a new type of Nitrogen-doped, atomically precise nanographene N-Dibenzo[*hi,st*]ovalene (N-DBOV) as an excellent pH- and metal-ion sensing probe. Like its DBOV parent[2] nanographene molecule, N-DOBV has excellent photo-physical properties, such as intrinsic blinking, high photo-stability, and high brightness with a quantum yield up to 76%, outperforming Alexa 647. Under identical continuous laser excitation conditions in air, N-DBOV retains a fluorescence intensity of 74% with an irradiation time of 450 seconds, while Alexa 647 photo-bleaches within 45 seconds. Such high photo-stability specifically benefits long term 3D fluorescence imaging applications. Secondly, the strong fluorescence of N-DBOV could be quenched with protons and heavy metal ions, in contrast to the parent DBOV, which shows no such response, indicating the unique potential of N-DBOV for the sensing applications. Thirdly, N-DBOV also shows pH-responsive blinking behavior at the single-molecule level, opening the way towards nanoscale pH environment detection in biological, environmental, and material research.

1. Richardson, D. S. *et al.* SRpHi ratiometric pH biosensors for super-resolution microscopy. *Nat. Commun.* **8**, 577 (2017).

2. Liu, X. *et al.* Nanographenes: ultrastable, switchable, and bright probes for super-resolution microscopy. *Angew. Chem. Int. Ed.* **59**, 496–502 (2020).