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Modifications of Polymer Nanoparticles as a Photocatalysts for Visible-Light-Driven Hydrogen Evolution

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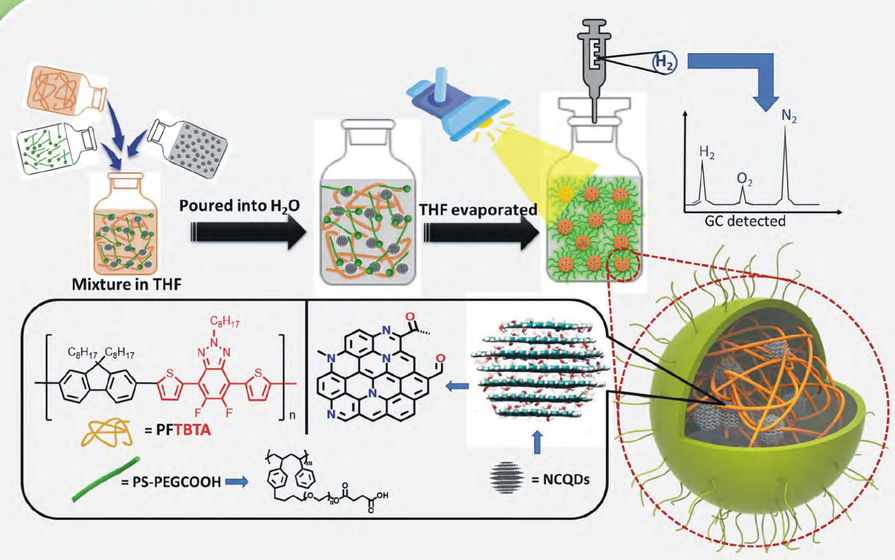
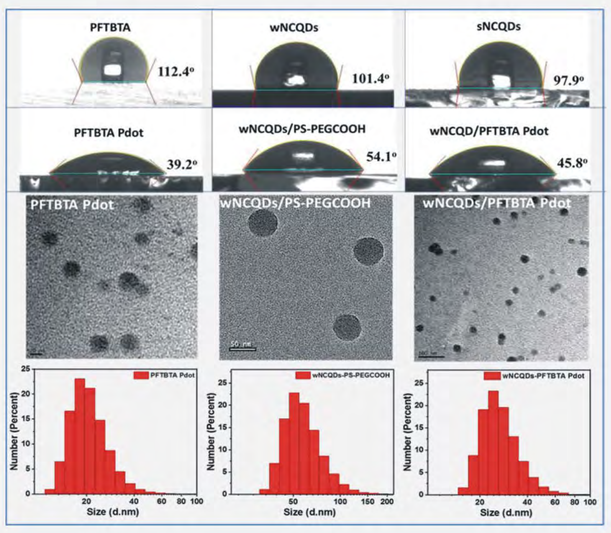
ABSTRACT

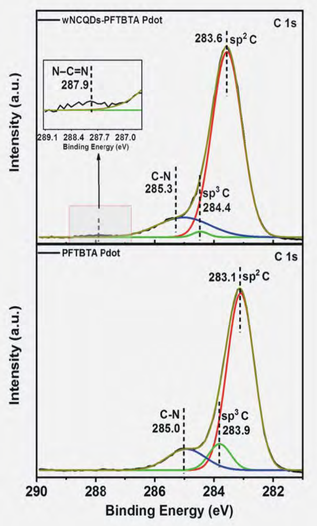
Given the photocatalytic properties of semiconducting polymers and carbon quantum dots (CQDs), we report a new structure for a metal-free photocatalytic system with a promising efficiency for hydrogen production through the combination of an organic semiconducting polymer (PFTBTA) and N-doped carbon quantum dots (NCQDs) covered by PS-PEGCOOH to produce heterostructured photocatalysts in the form of polymer dots (Pdots). On the other hand, we presents a new strategy for constructing binary Pdot photocatalysts by replacing the nonconjugated amphiphilic polymer typically employed in the preparation of polymer nanoparticles (Pdots) with a low-molecular-weight conjugated polyelectrolyte. The as-prepared polyelectrolyte/hydrophobic polymer-based binary Pdots truly enhance the electron transfer between the Pt cocatalyst and the polymer photocatalyst with good water dispersibility. Moreover, unlike the nonconjugated amphiphilic polymer, the photophysics and mechanism of this photocatalytic system through time-correlated single-photon counting (TCSPC) and transient absorption (TA) measurements confirmed the Förster resonance energy transfer (FRET) between the polyelectrolyte as a donor and the hydrophobic polymer as an acceptor.

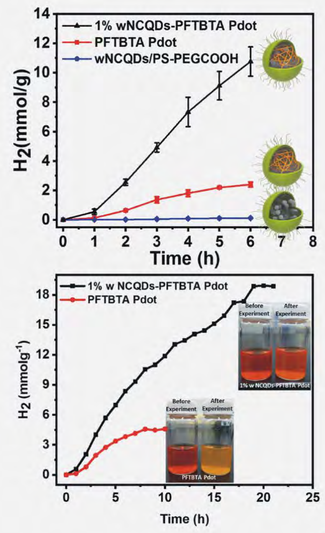
RESEARCH FOCUS



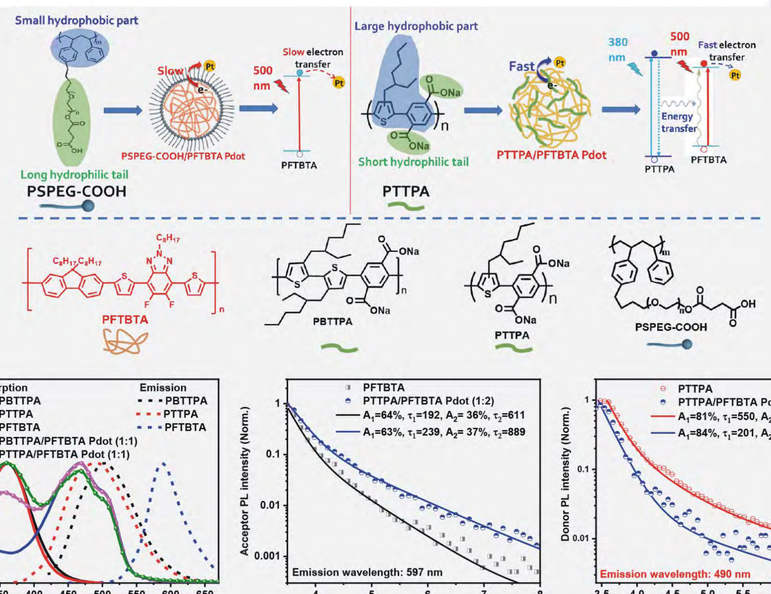
NCQDs implanted Pdots

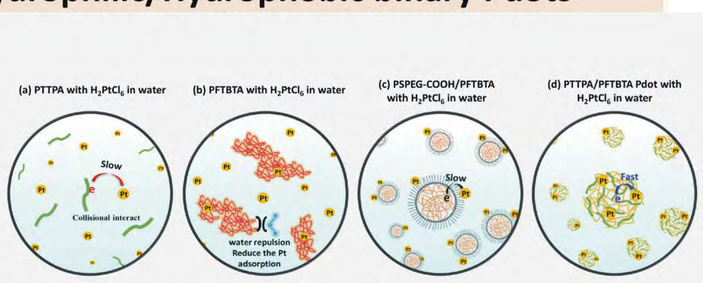


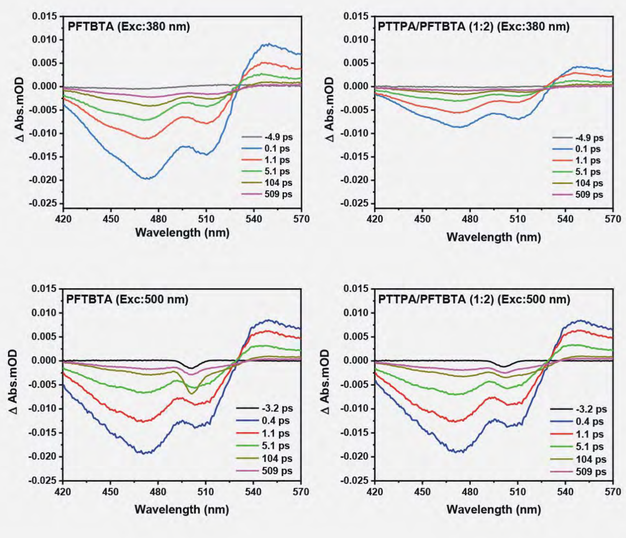


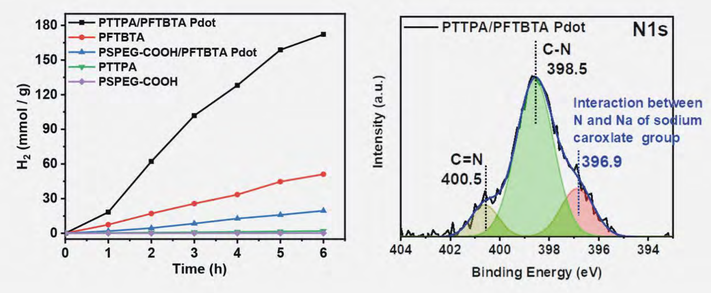


Hydrophilic/Hydrophobic binary Pdots









Conclusion

We believe that this work may provide new insights into the development of non-metal and inexpensive NCQD-based Pdot photocatalysts with high solar energy conversion efficiency in artificial photosynthetic systems. Moreover, the replacement of common non-conjugated amphiphilic polymer by our designated polyelectrolyte enhanced the electron transfer between the PFTBTA photocatalyst and Pt co-catalyst. The polyelectrolyte has been participating in the photocatalytic reaction through the FRET between the PTTPA and PFTBTA which demonstrated by transient absorption spectroscopy and time-correlated single-photon counting.

Selected Publications

1- **Mohamed Hammad Elsayed**, et al. Applied Catalysis B: Environmental 283 (2021): 119659. (IF:19.5)
2- **Mohamed Hammad Elsayed**, et al. Journal of Materials Chemistry A 9.15 (2021): 9780-9790. (IF:12.7)
3- **Mohamed Hammad Elsayed**, et al. ACS Applied Materials & Interfaces (2021): https://doi.org/10.1021/acsami.1c15812. (IF:9.2)
4- **Mohamed Hammad Elsayed**, et al. Journal of the Taiwan Institute of Chemical Engineers 115 (2020): 187-197. (IF:5.8)

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