Polymerization of bispyridylbutadiyne on surface evidenced by STM and application in photocatalysis

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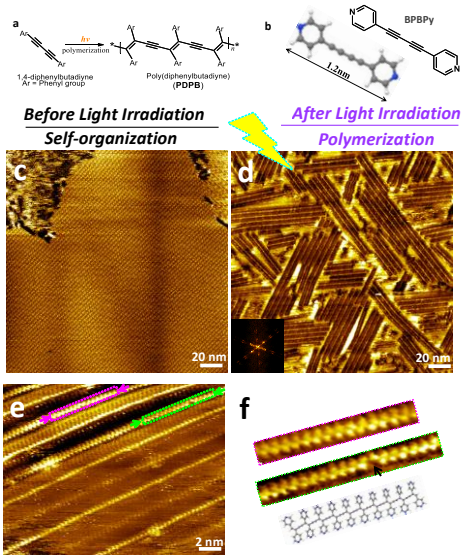
Solar-light-responsive photocatalyst technology, offering energy harvesting directly from solar light, holds great potential in water treatment as well as environmental purification. Lately, PDPB polymers belong to the family of poly(diacetylenes), have emerged as highly efficient photocatalysts under visible light where the preparation and the stability of such polymers are of great challenge and instability. Particularly, the polymers structures can have a strong impact to the catalytic efficiency.

Our work reveals direct on-surface photosynthesis of Poly-bis(pyridyl)butadiyne (PBPyB) from simple BPyB precursors. The BPyB monomers are first self-assembled on the graphite surface into highly ordered 2D-nanoarchitectures, and then irradiated by either UV or visible light. The large-scale transformation of the monomers into long straight 1D-conjugated polymer wires is revealed by scanning tunneling microscopy (STM). An inner-polymer trans positioning of the pyridine moieties is observed for the first time at the sub-molecular level. This polymer shows good photocatalytic activity for degradation of model pollutants in water.



(a) Photopolymerization pathway of BPBPy. (b) Molecular structure of BPBPy monomer. (c, d) Large-scale STM images acquired before and after UV irradiation, respectively. (e) High-resolution image of the polymer wires. (f) Enlarged STM images of the individual polymer wires.

To go step further towards more controllable on-surface photoreactions and more efficient catalytic procedures, the terminal groups from BPyB precursor were replaced by bipyridine units; complex on-surface photopolymerization is investigated with additional impacts of the molecular isomerization, light irradiation and PH variation.

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