Self-powered UV photodetectors with ultrahigh air stability based on a 2D coordination nanosheet

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Abstract

Organometallic two-dimensional (2D) nanosheets with tailorable components have recently fascinated the optoelectronic communities due to their solution-processable nature. However, the poor stability of organic molecules may hinder their practical application in photovoltaic devices. Instead of conventional organometallic 2D nanosheets with low weatherability, we synthesize an air-stable π-conjugated 2D bis(dithiolene)iron(II) (FeBHT) coordination nanosheet (CONASH) via bottom-up liquid/liquid interfacial polymerization using benzenehexathiol (BHT) and iron(II) ammonium sulfate [$Fe(NH_4)_2(SO_4)_2$] as precursors. The uncoordinated thiol groups in FeBHT are easily oxidized, but the $Fe(NH_4)_2(SO_4)$ dissociation rate is slow, which facilitates the protection of sulfur groups by iron(II) ions. The density functional theory calculates that the resultant FeBHT network gains the oxygen-repelling function for oxidation suppression. In air, the FeBHT CONASH exhibits self-powered photoresponses with short response times (< 40 ms) and a spectral responsivity of 6.57 mA W^{-1} under 365 nm illumination. Interestingly, the FeBHT self-powered photodetector revealed extremely high long-term air stability, maintaining over 94% of its initial photocurrent after aging for 60 days without encapsulation. These results open the prospect of using organometallic 2D materials in commercialized optoelectronic fields.

REFERENCES

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FIGURE

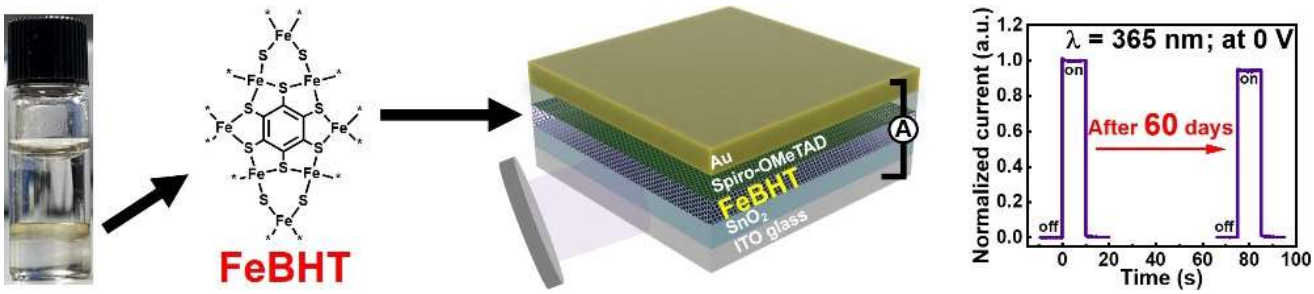

Figure 1: The organometallic FeBHT 2D CONASHs are used to fabricated self-powered photodetectors.