# COVALENT $P_3HT$ C60 NANOPARTICLES FOR PHOTOCATALYTIC HYDROGEN EVOLUTION

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This project stems from a growing interest in the use of organic photocatalysts and, more specifically, of conjugate systems, consisting of a polymer donor and a molecular acceptor, for hydrogen evolution.

We have tested the photocatalytic activity of a double-cable polymer composed of $P_3HT$, the donor, in the backbone and pendant C60, as molecular acceptor.

In this regard, we have developed a new synthetic strategy: the idea is to form Pt nanoparticles through photoreduction of its precursor and then to nanoprecipitate covalent $P_3HT$ C60. Ascorbic acid was used as sacrificial electron donor, after optimizing its concentration.

Recently, other research groups conducted photocatalytic studies on similar systems, where, however, the donor and acceptor are not covalently bound [1, 2]. The nanoparticles were synthesized by co-precipitation of the donor and acceptor and decorated with Pt nanoparticles, obtained, in that case, by photodeposition.

Comparing our results with those reported in literature, the use of a covalent system and the development of the new synthetic strategy for Pt nanoparticles formation introduce important advantages.

On one hand, the spectroscopic characterization (UV-vis absorption and emission spectra) and DLS reveal a greater stability of our nanoparticles. On the other, the hydrogen production rate, after two hours of irradiation with a white lamp, is significantly increased, as shown by gas chromatography results.

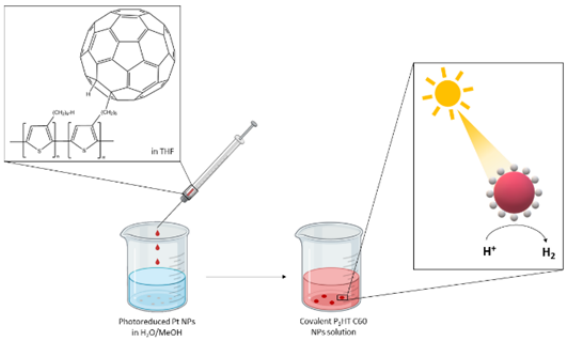


Figure 1. Representation of the nanoprecipitation strategy of covalent $P_3HT$ C60 (its structure is shown in the top left box). In the right inset there is a schematic of the photocatalytic system, consisting of covalent $P_3HT$ C60 NPs decorated with photoreduced Pt, for hydrogen evolution.

[1] Yang, H. et al. Conjugated polymer donor–molecular acceptor nanohybrids for photocatalytic hydrogen evolution. *Chemical Communications*, *56*(50), 6790-6793 (2020).

[2] Kosco, J. et al. Generation of long-lived charges in organic semiconductor heterojunction nanoparticles for efficient photocatalytic hydrogen evolution. *Nature Energy* 7(4), 340-351 (2022).