Organic molecule modified powder photocatalyst for visible light using hydrogen production in water medium

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Since sunlight can be used as a future light source, it is necessary to construct a system that efficiently transfers charges to the reaction site using visible light, which has 47% of the energy required for the photolytic decomposition of water. One of the approaches for this issue is introduced organic-modified photocatalyst for using visible responsible range. Here, I would like to show the examples of dye-sensitized type and z-scheme type visible light using photocatalytic hydrogen production in water medium.

Squaric acid and boron-dipyrromethene (BODIPY) are compounds with specific absorption at 600-700 nm. I have successively introduced on the surface of TiO_2 photocatalyst for dye-sensitized photocatalyst. As a result, these dyes modified photocatalysts showed visible light driven photocatalytic hydrogen production activity and showed as high as 1.3% apparent quantum efficiency at 700 nm with squaric acid type dye-modified TiO_2 photocatalyst.

To achieved z-scheme type photocatalytic reaction, I used potassium tantalate ($KTaO_3$) because of it showed a character of water splitting under UV-light irradiation. When I covered the surfaces of $KTaO_3$ with poly(3-hexylthiophene-2,5-diyl) (P3HT), the photocatalytic water splitting hydrogen production speed was improved from 24.5 μmol/h (without P3HT) to 57.9 μmol/h (with P3HT). This result suggested that P3HT may assist the charge separation to using photosynthesis under photoirradiation. The photoaction spectra showed that during $KTaO_3$ (UV) + dye (Vis) irradiation, the speed of water splitting increased corresponding to the absorption spectrum of the dye. This indicates that the photoexcitation of the dye is used for water splitting. On the other hand, water splitting did not occur even when only light was applied to the dye, indicating it was not a dye-sensitized type reaction but a z-scheme reaction with two-step excitation mechanism in this reaction.

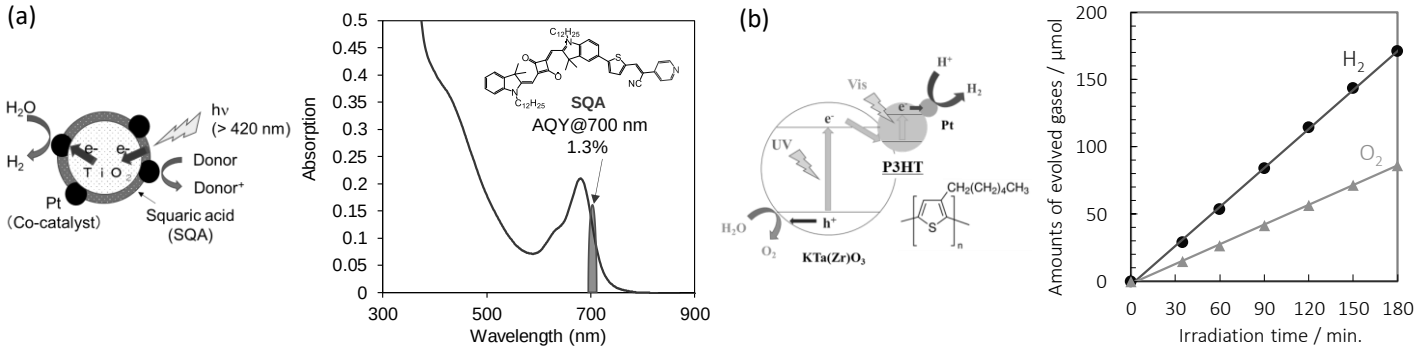

Fig. (a) Dye-sensitized type and (b) z-scheme type hydrogen production in water medium

References

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