Investigation of Photocatalytic CO_2 Reduction using Photoconductive Coordination Polymer with Metal–Sulfur Bonds

([1]*School of Science, Tokyo Institute of Technology*, [2]*School of Science, Kwansei Gakuin University*) ○Yoshinobu Kamakura,[1] Daisuke Tanaka,[2] Kazuhiko Maeda[1]

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CO_2 reduction by visible light has attracted much attention because of an increasing apply to sustain our society. Most photocatalytic systems for CO_2 reduction into HCOOH rely on precious and rare metal components such as Ru complexes for building block of photocatalytic system as catalytic and/or light-absorbing centers. Coordination polymers (CPs) are potential candidates because of their high structural designability. CPs containing the $(-M-S-)_n$ infinite sheet structure absorb visible light and appear high photoconductivity under irradiation. While CPs containing the $(-M-S-)_n$ structure are potential candidates for visible-light driven CO_2 reduction, however, there have been no investigation on their use as photocatalysts for CO_2 reduction.

We demonstrated that Pb-based photoconductive CPs containing the $(-Pb-S-)_n$ infinite sheet structure with semiconducting band structure.[1)] This CP photocatalyze CO_2 reduction upon visible-light to give HCOOH in the presence of electron donor (Figure 1). The photocatalytic activity showed high apparent quantum yields (2.6% at 400 nm; 12.4% at 365 nm) and selectivity (>99%). This is the first example of photocatalytic CO_2 reduction using CPs containing the $(-Pb-S-)_n$ infinite sheet structure, confirmed by isotope tracer experiment with $^{13}CO_2$.

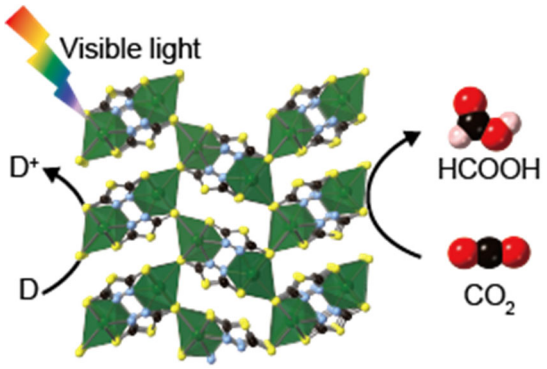

Figure 1. The schematic CO_2 photoreduction using Pb-based CPs containing the $(-Pb-S-)_n$ infinite sheet structure.

1) Y. Kamakura, S. Fujisawa, K. Takahashi, H. Toshima, Y. Nakatani, H. Yoshikawa, A. Saeki, K. Ogasawara, D. Tanaka, *Inorg. Chem.* **2021**, *60*, 12691–12695.