Decomposition of Perfluoroalkyl Substances by Near-UV and Visible Light Irradiation to Semiconductor Nanocrystals

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Perfluoroalkyl substances (PFAS) such as Teflon and Nafion are practically used in various industries, while their extremely high stability causes serious environmental persistence. Several decomposition methods have been reported: such as heating over 300-400 degree Celsius, strong oxidizing reagents, and irradiation of deep ultraviolet light. However, these methods are too harsh, and technology for decomposing PFAS has not been established to date. Recently, we reported that the powder of Cu-doped zinc sulfide (ZnS) NCs exhibit photochromic reactions by irradiation of 365-nm LED (Fig 1a).[1] The origin of the coloration is the ultralong-lived charge-separated (CS) state. We came up with the idea of using the ultralong-lived state to generate a higher excited state by stepwise two-photon absorption processes.[2]

In this study, we demonstrate that Cu-doped ZnS NCs can efficiently decompose perfluorooctanesulfonic acid (PFOS) by near UV and visible LED light at room temperature and atmospheric pressure (Fig 1b).

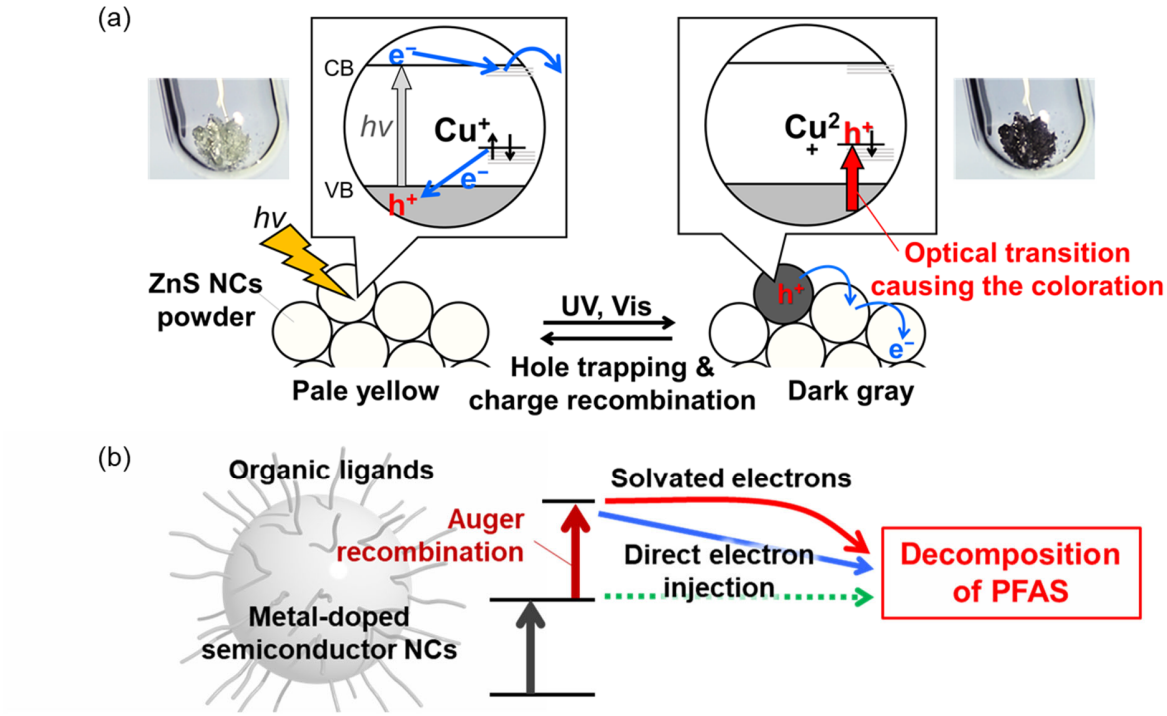

Fig. 1 (a) Photochromic reaction scheme of Cu-doped ZnS NCs and (b) plausible decomposition scheme of PFAS using Cu-doped ZnS NCs by irradiation of near UV and visible light LED light.

1) Y. Han, M. Hamada, I-Y. Chang, K. Hyeon-Deuk, Y. Kobori, Y. Kobayashi, *J. Am. Chem. Soc.* **2021**, *143*, 2239.
2) Y. Kobayashi, J. Abe, *Chem. Soc. Rev.* **2022**, *51*, 2397.