Development of Noble metals/TiO_2 photocatalysts for Photocatalytic Conversion of Methane coupling with Hydrogen Evolution from water

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Methane, the main component of natural gas (< 80%), is an expressive source of carbon and hydrogen, with large world reserves and can be used as raw material to produce petrochemicals and fuels; however, efficient CH_4 conversion under mild conditions remains a challenge due to its low reactivity. In addition, the methane conversion coupled with water splitting, which is the purpose of this work, is quite interesting and desirable, due to the production of hydrogen in a more sustainable way.[1]

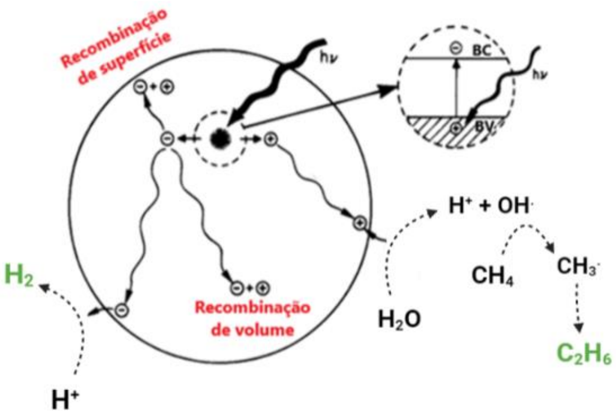

Figure 1: Photoactivation of a semiconductor in aqueous suspension.[2]

One of the alternative ways to convert CH_4 under low temperatures is Heterogeneous Photocatalysis, which will be used in the present study. When a semiconductor photocatalyst absorbs light with a wavelength greater than or equal to its bandgap, electrons are photoexcited to the conduction band and holes (h^+) are formed in the valence band, forming the so-called electron-hole pairs, which in turn can initiate various redox reactions (Figure 1).[3]

Solar Photocatalysis would be an ideal method to convert methane and produce hydrogen from water. In this project, photocatalysts with different compositions and morphologies will be developed based on noble metals nanoparticles (Pt, Pd, Au, Ag) supported on TiO_2 P25. The final goal is to obtain more active photocatalysts to increase the quantum efficiency of the system.

[1] XU, Z.; BIAN, Z. Photocatalytic methane conversion. Journal of Physics and Chemistry, v. 36, n. 3, p. 1–11, 2020.

[2] LINSEBIGLER, A. L.; LU, G.; YATES, J. T. Photocatalysis on TiO_2 Surfaces: Principles, Mechanisms, and Selected Results. Chemical Reviews, v. 95, n. 3, p. 735–758, 1995.

[3] YU, L., SHAO, Y., & LI, D. Direct combination of hydrogen evolution from water and methane conversion in a photocatalytic system over Pt/TiO_2. Applied Catalysis B: Environmental, v. 204, p. 216–223, 2017.