Robocasting fabrication of TiO2-supported WO3 catalysts for the solar-driven production of ammonia

Anderson Luis Barbosa[1], Priscila Hasse Palharim[2], Andre Luiz da Silva[1], Douglas Gouvea[1], Bruno Ramos[3]

[1]Escola Politécnica de Universidade de São Paulo (*Departamento de Engenharia Metalúrgica e de Materiais*) , [2]Escola Politécnica de Universidade de São Paulo, [3]Centro Universitário da Fundação Educacional Inaciana Pe Sabóia de Medeiros

e-mail: albarbosa@usp.br

The increasing global demand for ammonia, particularly now that it has emerged as a relevant hydrogen carrier, stresses the need for development of sustainable and energy-efficient synthesis methods. Traditional Haber-Bosch ammonia synthesis is energy-intensive, reliant on fossil fuels, and contributes significantly to CO2 emissions. One promising alternative involves the use of solar energy to activate nitrogen reduction reactions. In this work, we report the fabrication of titanium dioxide (TiO2)-supported tungsten trioxide (WO3) catalysts, as suitable catalysts to harness solar energy efficiently. The TiO2 support was prepared using a direct-ink writing (3D printing) technology [1]. WO3 was coated using a spray pyrolysis technique followed by calcination [2]. Characterization techniques, including XRD, SEM, and UV-Vis diffuse reflectance spectroscopy, confirmed the successful incorporation of WO3 on TiO2. The catalysts were used to assemble a fixed-bed photoreactor, operated under simulated sunlight. N2-saturated deionized water is recirculated through the photoreactor and the light source is turned on. Samples are collected periodically and the NH4+/NH3 contents are determined using a colorimetric method [3]. Photocatalytic tests are being carried out to compare the efficiency of the fixed-bed catalysts with their dispersed powdered equivalents and other suitable materials as reported in the literature. Preliminary results have shown that ammonia is produced, confirming the functionality of the catalyst. Detailed quantification is still under way, and will be presented and discussed at the conference.

Acknowledgements: The authors acknowledge the support of FAPESP (23/14214-4)

References:
[1] BAE Ben-Arfa et al., Nanomaterials, 14, 4994, 2022.
[2] PH Palharim et al., Abstracts of the 8th Intnl. Conf. Semicond. Photochem., P-85, 2023.
[3] HS Jeong et al., J. Chemistry, ID 359217, 2013.