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Facile microwave synthesis of hybrid ZnTiON@S-C_3N_4 nanosheets for solar-remediation of blue dyes from wastewater

Sherif A Younis[1, 2] and **Philippe Serp**[2]
[1]Egyptian Petroleum Research Institute, Egypt
[2]ENSIACET - Université de Toulouse, France

In this work we report the fabrication of hybrid Zn0.05TiON@S-C3N4 nanosheets having tunable and intrinsic electronic/band structure modulation with optical energy (Eg ~ 2.73 eV) via the one-step growth of sulfur doped carbon nitride sheet over Zn0.05TiON oxynitride catalyst assisted by microwaves. Photocatalytic activities of the prepared photocatalysts are investigated by monitoring the discoloration of blue dyes (Methylene blue and Brilliant blue) in wastewater solution under three wavelengths of UVC, visible and solar radiation. By using statistical response surface methodology (RSM), a statistical second-order polynomial model equation was developed with goodness of fit (R2>0.99 with 2.19% standard error deviation) to represent the relationship between the dyes discoloration efficiencies and the influential ranges of six-photocatalytic parameters at three levels, in order to increase and optimize process ecnomic viability for time saving. Interestingly, at 80 µmol blue dyes concentration, the developed model suggested 100% discoloration efficiency from 1000 mg/L saline wastewater at 2.19 g/L Zn0.05TiON@SCN, 7.98 pH, 0.98% H_2O_2 content and solution temperature at 28.4oC after 27 min of UVC irradiation light. Under these operating parameter levels, the experimental discoloration rate was determined to be 99.2±1.82%, which is in a close agreement to the predicted value. In addition, the notable experimental photo-remediation rates of dyes contaminated wastewater under visible and solar radiation by the synergic of Zn0.05TiON@SCN heterojunction photocatalyst were found respectively to be ≈ 82.8±3.81% and 95.1±4.09% after 90 min. This work proves the power of Zn0.05TiON@SCN as solar-photocatalyst to provide sustainable clean water resources, which are also beneficial for improving photocatalytic hydrogen evolution activity from industrial waste water in future through solar-photoconversion of organic pollutant for zero-waste production and green environment.

sherifali_r@yahoo.com