Evaluation of Reaction Parameters in Polymeric Carbon Nitride Hybridized ZnO Nanocomposite for Improving Photocatalytic Activity using Thermal Synthesis

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Recently, semiconductor photocatalyst has garnered a lot of interest, as it has significant promise for environmental restoration and the generation of green hydrogen energy. The polymeric carbon nitride (PCN) and ZnO have been investigated in various catalytic reactions such as organic pollutant degradation and water splitting due to their relative inexpensiveness, moderate band gap (2.7 -3.0 eV), high thermal conductivity, and chemical stability [1]. However, the PCN is found to exhibit less applicability as a photocatalyst for water splitting due to the low surface area, high charge recombination probability, and weak visible light absorption, which is also dependent on the synthesis methodology. Since then, many efforts have been dedicated to the enhancement of the photocatalytic activity of PCN. Previously, in our group, we had successfully obtained PCN-AlOOH-ZrO2 nanocomposite, having a higher specific surface area of about 79.5 m^2/g and a band gap of 3.0 eV [2]. We have also shown that the size of ZnO particles can be controlled with the water concentration and achieved the highest specific surface area (59.4 m^2/g) [3].

Primarily, our goal is to present the development of nanomaterial synthesis to obtain the repeatable homogenous nanostructure, having a high specific surface area with narrowing the band gap which will enhance its photocatalytic activity for hydrogen evolution reaction. We have investigated the structural morphology and its stability through SEM, XRD, and ATR-FT-IR. This PCN nanocomposite was obtained by two steps: 1) microwave hydrothermal synthesis of ZnO followed by drying and 2) mixing the ZnO with different proportions of melamine and annealing in air at 550° C using a muffle furnace for 3hrs. The synthesized ZnO nanoparticle has an average grain size of 25 nm with BET_{SA} 45.483 m^2/g and a density of 5.22±0.0.04 g/cm^3. We observed the strong XRD peak of PCN (at 28.33°) and 31.75°, 36.25° and 62.87° XRD peaks for ZnO hexagonal phase, which confirms the PCN-ZnO formation as shown in Figure 1, except 70% of ZnO. In near future, we will investigate other fundamental properties and photocatalytic activities with both experimentally and with density functional theory methodology.

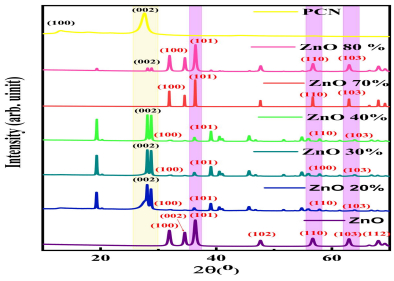

Figure1: XRD diffraction pattern of PCN, ZnO and PCN-ZnO nanocomposite.

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