Photoreforming hydrogen production by carbon doped exfoliated g-C3N4: Optimization using design expert®software

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ABSTRACT
Carbon doping was ascertained as a best strategy to improve the surface area and electronic properties of g-C3N4. Additionally, the carbon material could extend the delocalization of pi-electrons consequently fostering the photocatalytic reactions. Herein, a newly formulated carbon doped exfoliated g-C3N4 was prepared by a facile hydrothermal technique. The photocatalytic experiments using formaldehyde aqueous solution was employed to examine the effect of time and catalyst dosage. Response surface methodology (RSM) was used to optimize the reaction parameters and determine the best operating conditions using Design Expert Software Version 7.1.6. The changes in the functional groups of the catalyst before and after the reaction was characterized by FTIR analysis. As a result, the characteristic peak of tri-s-triazine located at 802 cm−1 was present in the recycled catalyst. This outcome confirms that the melon structures were not destroyed after the reaction thereby revealing better stability of the catalyst. UV–Vis DRS analysis was used to evaluate the band gap of the as-prepared catalysts. From the one-factor-at-a-time (OFAT) results, the range of the independent variables were selected as follows: time (4–8 h) and catalyst dosage (0.5–1 g/L). Based on the central composite design (CCD) matrix, the optimum conditions for hydrogen yield (920 µmol/g) were observed at 6 h using 0.75 g/L of catalyst. In the optimization process, the response of the interactions between the parameters were given by the polynomial quadratic model and 3D plot. The influencing factors on the reaction were analysed by Analysis of Variance (ANOVA). The highest R-squared value of 0.9797 and F-value of 46.31 evidenced an excellent fitting of the model. Hence, this work provides some insights on the development of Carbon doped exfoliated g-C3N4 with their contribution towards photocatalytic field.

KEYWORDS
Design expert; Doping; Hydrogen; Optimization; Photoreforming

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