Quenching induced structural distortion of graphitic carbon nitride nanostructures: Enhanced photocatalytic activity and electrochemical hydrogen production

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Photoluminescence (PL) spectra and photocurrent measurement was carried out to examine the photoinduced electron-hole recombination in g-C$_3$N$_4$. The photoluminescence (PL) spectra of bare g-C$_3$N$_4$, ice quenched g-C$_3$N$_4$ and liquid nitrogen quenched g-C$_3$N$_4$ was measured at room temperature. The bare g-C$_3$N$_4$, ice quenched g-C$_3$N$_4$ and liquid quenched g-C$_3$N$_4$ showed a emission band at 438 nm as shown in Figure S1(a). The PL intensity of nitrogen quenched g-C$_3$N$_4$ was low when compared with the other two g-C$_3$N$_4$ samples. The PL intensity is usually ascribed to the recombination of photoinduced electron-hole. Therefore the recombination of photoinduced electron-hole in the N2 quenched g-C3N4 is very less.

Further, the photocurrent behavior was studied to understand the electron-hole separation. Photocurrent measurement of the prepared G1, G2 and G3 samples was measured using an electrochemical analyzer. Here all the samples were coated on a indium tin oxide glass which served as the working electrode. A 300W Xe arc lamp was used as the light source. Figure S1(b) represents the photocurrent-time curves of the samples. Under the visible light condition, the photocurrent increased in the G3 sample when compared with the G1 and G2 samples. This result shows that the quenched samples have less charge carrier recombination.

In addition, the photocurrent is steady and repeatable.
The identification of the intermediate organic compounds of the methylene blue dye degradation was carried out using the LC-MS spectroscopy. LC-MS analysis shows the formation of many organic intermediates with m/z values of 316, 270, 166, 136, 130, 111, 110, 102, 94, 83 and 82. Figure S2 Shows the photocatalytic degradation pathway of the methylene blue dye. The C-N, C-S bonds are continuously broken and then oxidized to form water, carbon di oxide and sulphate ions.

Figure: S2. Proposed scheme for the formation of possible oxidation intermediates of the methylene blue.