Electronic Supplementary Data

Combined effect of adsorbent chitosan and photosensitizer polypyrrole in ternary chitosan-polypyrrole-TiO₂ photocatalyst leading to visible light activity and superior functionality

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Synthesis of chitosan-polypyrrole-TiO₂

The ternary photocatalyst chitosan–polypyrrole–TiO₂ (Chit-Ppy-TiO₂) was synthesized using a typical two step process. In a typical process, a known amount of TiO₂ was added into Chit dissolved in 3% acetic acid solution and the resultant mixture was stirred for 30 min followed by 10 min ultrasonication to get a homogeneous dispersion of TiO₂ particles. The stirring was continued for further 30 min by adding calculated quantity of polypyrrole for facilitating the adsorption of pyrrole onto TiO₂ surface. Pyrrole was polymerized over TiO₂ particle at room temperature (~30°C) by adding anhydrous FeCl₃ (pyrrole:FeCl₃ = 1:2). The pH of the above product solution was adjusted to 9 using 1M NaOH for the deposition of Chit over Ppy/TiO₂. The obtained photocatalyst was filtered, washed thoroughly with deionised water and dried at 80°C. The dried catalyst was made fine powder and labelled respectively with the initial weight ratios of Chit, Pyrrole and TiO₂. The catalyst with varying three components viz. 1:1:1, 1:1:5, 1:1:20, 1:1:50 and 1:1:100 were synthesized and labelled accordingly. The binary photocatalysts Chit–TiO₂ and Ppy–TiO₂ were also prepared keeping wt ratio of Chit or Ppy to TiO₂ at 1:100.

Photocatalysis experiment

The photocatalytic activity of the synthesized catalysts was evaluated using methylene blue (MB) as a model dye at various pHs (4-10) with 200 ml of 10-100 mg/l (ppm) MB aqueous dye solution, 2 ml H₂O₂ and 100 mg catalyst. The degradation reaction was conducted in an immersion type (Heber photoreactor, model HIPR LC-150) photoreactor fitted with 150 W tungsten-halogen lamp (λ ≥ 400 nm: intensity = 14.79 mW/cm² at 555 nm). The degradation reaction was monitored after 1/2 h by withdrawing 2 ml sample solution followed by its dilution, centrifugation and absorbance measurement at 650 nm (UV-vis Spectrophotometer; Perkin Elmer Lambda 25). The % degradation of MB was calculated from Eq. (1) using absorbance value.

\[
\text{% degradation} = \frac{[\text{MB}]_o - [\text{MB}]_t}{[\text{MB}]_o} \times 100 \quad (1)
\]

where, [MB]₀ = initial concentration of MB and [MB]ₜ = concentration of MB after t time.
Fig. S1 — BET surface area isotherms of (a) TiO$_2$, (b) Chit-Ppy-TiO$_2$ (1:1:1) and (c) Chit-Ppy-TiO$_2$ (1:1:100).

Fig. S2 — Visible spectral changes of MB at various time intervals during its degradation over Chit-Ppy-TiO$_2$(1:1:100).
Fig. S3 ─LC-MS spectra of MB degraded products.