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Deprotonation and loss of the conductivity of PPy/TiO_2 nanocomposite photocatalyst under alkaline conditions for photocatalytic application

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By *in-situ* chemical oxidation polymerization, polypyrrole/titanium dioxide (PPy/TiO_2) nanocomposite photocatalysts were prepared for photocatalytic wastewater purification under simulated solar irradiation. To enhance TiO_2 photoactivity under visible light and to reduce economic expenses during wastewater treatment, PPy conductive polymer was applied. Conductive PPy polymers with extending conjugated electron systems act as stable photosensitizers injecting electrons into the conduction band of TiO_2 (due to their π conjugated electrons). The study was aimed elucidate the stability and loss of conductivity under alkaline conditions during photocatalysis. The deprotonation, which is responsible for conductivity reduction, is discussed on the bases of salt–base transition in polypyrrole due to treatment of nanocomposite by ammonium hydroxide (NH_4OH). The stability towards the loss of conductivity by deprotonation was validated by measuring their electroconductivity and photocatalytic activity. Further, studied PPy/TiO_2 nanocomposite photocatalysts were characterized by FTIR and spectroscopy, TG analysis and SEM microscopy. Photocatalytic activity of PPy/TiO_2 nanocomposite photocatalysts was estimated by monitoring the discoloration of Reactive Red (RR45) azo dye in wastewater monitored by UV/Vis spectrophotometer at the maximum wavelength (λ_{max}=542 nm). The kinetics of photocatalytic degradation rate of RR45 was studied as well. The mineralization process was followed by determination of total organic carbon (TOC). From the results it was concluded that deprotonation process significantly decreased the conductivity of PPy/TiO_2 nanocomposite photocatalysts since the conductivity of 17.6 S/cm was observed after *in-situ* synthesis and only $7.1x10^{-5}$ S/cm was notified after the deprotonation. The consequence of deprotonation was also lower photocatalytic degradation rate of RR45 dye in wastewater purification.

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