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A study of temperature and nickel titanium trioxide effect on the thermal generation of carbon nitride

Graphitic carbon nitride (g-C_3N_4) has become new research hotspot and attract many attentions as a metal-free semiconducting visible-light responsive photocatalyst. This is due to its suitable band gap energy (2.7-2.8 eV), high physicochemical stability and "earth-abundant" nature [1]. Graphitic carbon nitride is essentially high molecular compound which is fabricated by thermal polymerization of nitrogen-rich precursors such as melamine, dicyandiamide, cyanamide, urea, thiourea, ammonium thiocyanate [2, 3]. Herein, graphitic carbon nitride was used to create heterojunction nickel titanium trioxide ($NiTiO_3$) to improve $NiTiO_3$ photocatalytic activity under visible-irradiation, which is a common method to increase catalyst properties. The interesting point is, during the synthesis process of composite, we realize that $NiTiO_3$ has performed as a catalyst for the polymeric reactions, thus shift to lower temperature of some steps as well as reduce the enthalpy.

The as-synthesis samples were studied of thermal properties by simulation heat treatment process with thermalgravimetric analysis (TGA-DTG) and differential scanning calorimetry (DSC). Based on the TGA-DTG and DSC data, the real process was conducted at different chosen temperature. The final products were once again studied with TGA-DTG and DSC, as well as characterization with other common analytical methods. Afterward, we found the optimum temperature to produce $NiTiO_3/C_3N_4$ composites as well as promote an overall knowledge of polymerization process with $NiTiO_3$ as catalyst.

Finally, these composites were applied to remove methylene blue under visible-irradiation. Without the coupling, $NiTiO_3$ nor C_3N_4 themselves have lower photocatalytic activity than the composites. Carbon nitride not only significantly enhances the adsorption ability but also promote a charge center, thus reduce the electron-hole recombination rate and increase the reaction rate.

References

[1] W.-J. Ong, L.-L. Tan, Y.H. Ng, S.-T. Yong, S.-P. Chai, Chem. Rev. 116 (2016) 7159-7329.
[2] Q. Su, J. Sun, J. Wang, Z. Yang, W. Cheng, S. Zhang, Catal. Sci. Technol. 4 (2014) 1556-1562.
[3] W. Zhang, Q. Zhang, F. Dong, Z. Zhao, Int. J. Photoenergy 2013 (2013) 9.

Figures

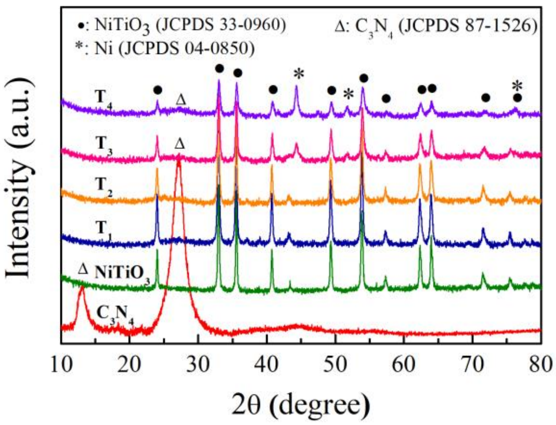

Figure 1: XRD patterns of pure C_3N_4, pure $NiTiO_3$ and composite $NiTiO_3/C_3N_4$ thermal treated at different temperature T_i.

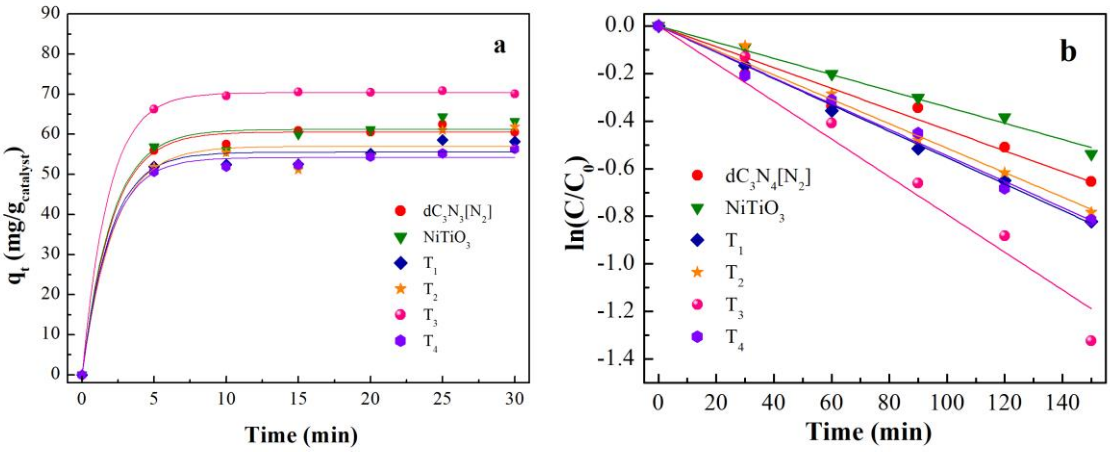

Figure 2: (a) Second-order kinetics plots and (b) Apparent first-order kinetics of photocatalytic degradation of methylene blue under visible-illuminated of catalysts.