In situ sol-gel Polybenzimidazole/Titanium dioxide nanocomposite materials for photocatalytic degradation of Reactive Black 5 azo dye

Silvia Dimova[a], Katerina Zaharieva[b], Filip Ublekov[a], Hristo Penchev[a], Irina Stambolova[c]

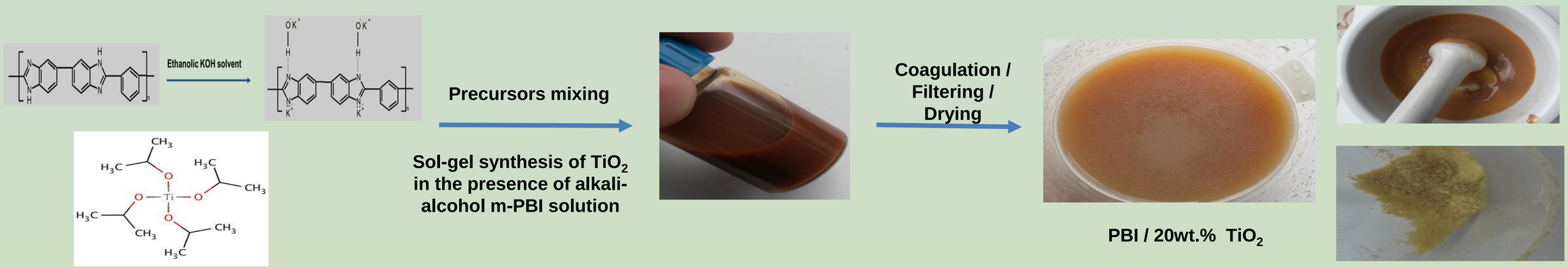
[a]Institute of Polymers, Bulgarian Academy of Sciences, "Akad. G. Bonchev" St., Bl.103A, Sofia, Bulgaria
[b]Institute of Mineralogy and Crystallography "Akad. I. Kostov", Bulgarian Academy of Sciences, "Akad. G. Bonchev" St., Bl. 107, Sofia, Bulgaria
[c]Institute of General and Inorganic Chemistry, Bulgarian Academy of Sciences, "Akad. G. Bonchev" St., Bl. 11, Sofia, Bulgaria

GOAL

- Synthesis of Polybenzimidazole/Titanium dioxide nanocomposite materials.
- Characterization of prepared nanocomposite powders using Fourier-transform infrared spectroscopy and powder X-ray diffraction analysis.
- Investigation of the photocatalytic efficiency of the nanocomposites in the reaction of degradation of Reactive Black 5 (RB5) dye under UV light.

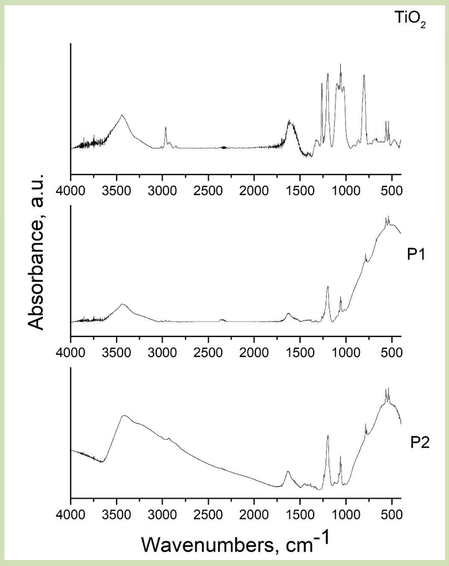
SYNTHESIS

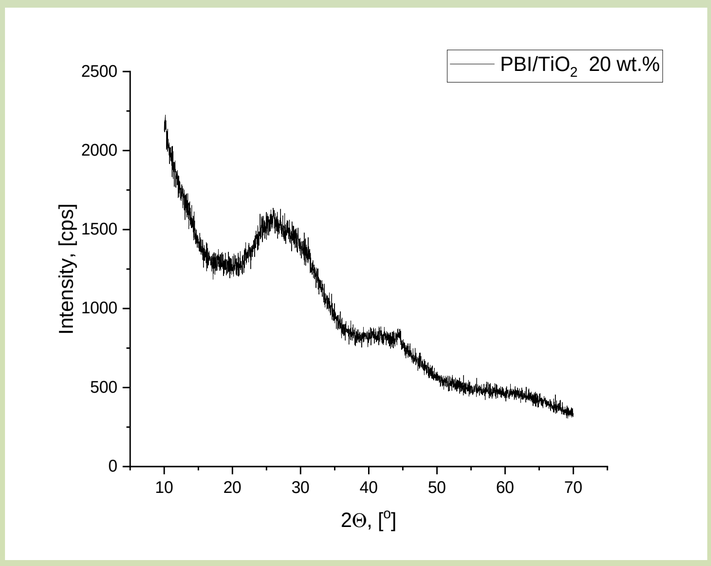
Nanocomposite hybrid powders of meta-Polybenzimidazole (PBI)/Titanium dioxide containing 20 wt.% of titania nanoparticles were synthesized by a new in situ sol-gel process with the use of different potassium hydroxide PBI low-alcohol mixtures and titanium (IV) isobutoxide as nano sized titania precursor. In this approach we used the property of PBI to readily dissolve in alkali-alcohol solutions which instantly react with titanium (IV)alkoxide precursors by a sol-gel process forming amorphous nano sized titania phase surface stabilized by the PBI conjugated macromolecules. Three different sol-gel samples were investigated in regards of low-alcohol content – these are: PBI/KOH/96% EtOH; PBI/KOH/abs EtOH and PBI/KOH/n-butanol denoted as P1, P2 and P3, resp. After filtration and vacuum drying and mortar grinding the obtained hybrid powder samples were thermally treated at 370°C for 2 hours.



RESULTS

Characterization

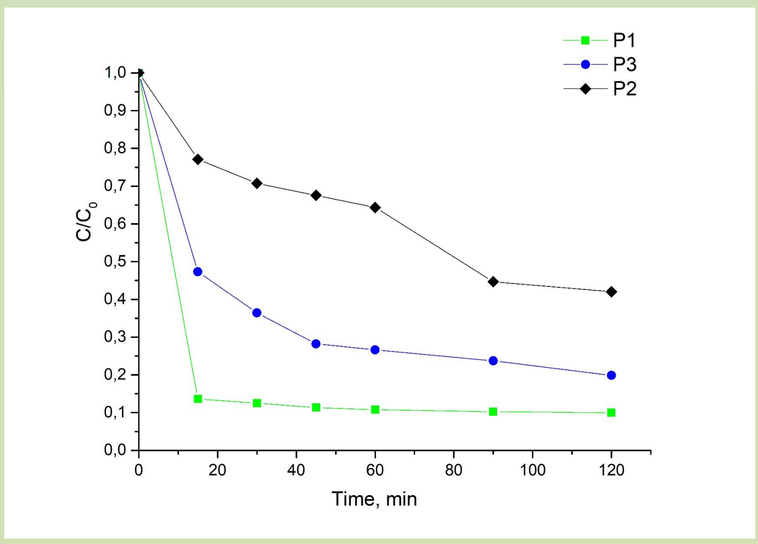




FT-IR spectra and PXRD pattern of prepared PBI/TiO_2 hybrid materials.

Photocatalytic investigations

The photocatalytic ability of the synthesized Polybenzimidazole/Titania hybrid nanocomposites were investigated for photocatalytic degradation of RB5 azo dye as model contaminant from aqueous solution (5 ppm) under UV illumination.



The concentration ratio C/C_0 of the RB5 dye in aqueous solution with time under UV irradiation using prepared nanomaterials as photocatalysts.

CONCLUSIONS

- Polybenzimidazole/Titanium dioxide nanocomposite hybrid materials containing 20 wt.% of titania have been successfully prepared by in situ sol-gel process with the use of different potassium hydroxide PBI low-alcohol mixtures and titanium (IV) isobutoxide precursor.
- The XRD analysis confirms the amorphous phase of TiO_2.
- The degree of degradation of Reactive Black 5 dye at 120 minutes UV irradiation is 58-90 %, using synthesized PBI/TiO_2 nanocomposites as photocatalysts.