Peptization technique in the synthesis of titania-silica composites and their photocatalytic properties

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Abstract

A comparative study of titania-silica composite (TSC) synthesized via peptization sol-gel method was conducted. Typically, titanium hydroxide gel ($Ti(OH)_4$) was formed by condensation of titanium oxychloride solution using adequate amount of ammonium hydroxide solution. The preformed gel was peptized either in silicic acid (SA) or nitric acid (NA) to form a sol. The composite was characterized by XRD, FTIR, SEM, TEM, TGA, and N_2 physisorption studies. The XRD patterns and the TEM micrographs confirmed that thermal-derived samples of the composite, formed using silicic acid as a silica source and peptizing agent (TSC-SA), yielded TiO_2-SiO_2 composite with a single-phase (anatase phase); while a mixture of both anatase and rutile phases were observed in the composite (TSC-NA), where nitric acid was used as a peptizing agent. FTIR analysis showed the vibration band assignable to the Ti-O-Si bond at 945 cm^{-1}, suggesting that titania was incorporated into silica

to form a composite. Furthermore, a simple experiment of photodegradation of methyl orange in the presence of sunlight was performed to demonstrate the practical efficacy of the composites synthesized via this method. The results indicated that the calcined samples of TSC-NA-800 had the highest activity due to its superior properties.