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Preparation of TiO_2–$BaSO_4$ composite microparticles and their photocatalytic activity

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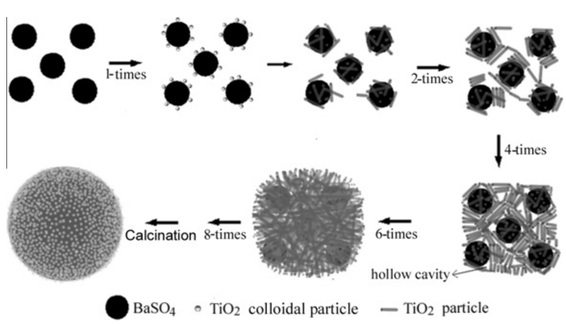
HIGHLIGHTS

- ▶ TiO_2–$BaSO_4$ composite microparticles (TBCMs) were obtained using a novel method.
- ▶ TBCMs showed pronounced mesoporosity and large surface areas.
- ▶ TBCMs exhibited the higher adsorption capacity and photocatalytic activity.

GRAPHICAL ABSTRACT



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ABSTRACT

The controlled synthesis of titanium oxide–barium sulfate composite microparticles (TBCMs) and their photocatalytic activity were investigated. Spherical TBCMs with hollow internal cavities were obtained via multi-time composited growth. The TBCMs were composed of rutile TiO_2 nanorods and $BaSO_4$ balls. With increasing number of compositing times, the TBCMs became more compact, and their sizes gradually increased. Homogeneous TBCMs with sizes ranging from 1.5 μm to 2.0 μm were formed after eight times of compositing. The TBCMs showed pronounced mesoporosity with a very narrow pore-size distribution and large surface areas. Among the various samples produced, those obtained after 8 times of compositing exhibited the highest adsorption and photocatalytic activities. TBCM photocatalysts could thus be reused effectively for several times with high catalytic reactivity.

1. Introduction

Nanosized titanium oxide (TiO_2) has been proven to be an excellent photocatalyst for the degradation of several environmental contaminants because of its high catalytic efficiency, energy-saving characteristics, non-toxic nature, and chemical inertness, among others [1,2]. However, aggregation and difficulties in product recovery often limit the application of TiO_2. To solve these problems, numerous materials have been tested as carriers of TiO_2 nanoparticles to form TiO_2-based composite microparticles [3–15]. TiO_2 composite microparticles were reported to be more active than pure TiO_2 photocatalysts [5,6] and have likewise been proven to exhibit rapid sedimentation with settling velocities that are nearly 100 times faster than that of naked TiO_2 [7]. Furthermore, the removal of TiO_2 microcomposites from pollutant degradation systems is significantly easier than that of nano-TiO_2 particles, thus making TiO_2 microcomposites promising candidates for further industrial application.

The photocatalytic activity of TiO_2 generally increases with increasing specific surface area [6,16]. Therefore, various strategies have been used to generate TiO_2 with large surface areas, such as the preparation of porous TiO_2 microcomposites and films [6,16–21]. The preparation of micrometer-sized TiO_2 composites

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