Preparation of TiO₂–BaSO₄ composite microparticles and their photocatalytic activity

Rufen Chen a,*, Juan Zhou a, Bin Xu b, Xiangmin Meng c

a College of Chemistry and Material Science, Hebei Normal University, Shijiazhuang 050024, PR China
b Inspection and Quarantine Technology Center of Hainan Entry–Exit Inspection and Quarantine Bureau, Haikou 570311, PR China
c Key Laboratory of Photochemical Conversion and Optoelectronic Materials, TIPC, Chinese Academy of Sciences, Beijing 100190, PR China

HIGHLIGHTS
- TiO₂–BaSO₄ 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.

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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 TiO₂ nanorods and BaSO₄ 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 (TiO₂) 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 TiO₂. To solve these problems, numerous materials have been tested as carriers of TiO₂ nanoparticles to form TiO₂–based composite microparticles [3–15]. TiO₂ composite microparticles were reported to be more active than pure TiO₂ 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 TiO₂ [7]. Furthermore, the removal of TiO₂ microcomposites from pollutant degradation systems is significantly easier than that of nano-TiO₂ particles, thus making TiO₂ microcomposites promising candidates for further industrial application.

The photocatalytic activity of TiO₂ generally increases with increasing specific surface area [6,16]. Therefore, various strategies have been used to generate TiO₂ with large surface areas, such as the preparation of porous TiO₂ microcomposites and films [6,16–21]. The preparation of micrometer-sized TiO₂ composites...