The second life of waste glass: Glass Microspheres production and versatile applications

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Abstract

Glass recycling is far less straightforward than it appears. Using a cullet as a feedstock to fabricate original articles by remelting cannot always be applied. Some glasses are 'unrecyclable' for several reasons, including the risks of degradation of their properties or the loss of chemical purity. The main obstacle to reusing glass waste is that it should pass through various expensive and time-consuming steps. Technological progress is necessary to improve production efficiency, environmental quality, and economic competitiveness. Moreover, the development of new applications is required due to the non-biodegradable nature and increasing quantities of waste. Achieving certain goals can be accomplished by producing glass microspheres of various forms (solid, hollow, and porous) through innovative flame synthesis techniques for diverse applications.
Pharmaceutical glasses in a borosilicate system were used to fabricate novel transparent and porous 3D glass structures. Fiberglass waste was subjected to alkali activation in an aqueous solution with different sodium/potassium hydroxide concentrations. The activated materials were fed into a methane–oxygen flame with a temperature of around 1600 ∘C to produce porous glass microspheres. The highest homogeneity and yield of porous glass microspheres (PGMs) corresponded to the activation with 9 M KOH aqueous solution. The obtained PGMs were used to prepare highly porous pellets with a specific surface area of nearly 20 m2/g, which is applicable for removing methylene blue as a model organic dye from wastewater. Moreover, 3D photocatalysts containing PGMs doped with TiO2 nanoparticles have been fabricated using the masked stereolithography technique.

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