Functional photothermal sponges for efficient solar steam generation and accelerated cleaning of viscous crude-oil spill

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ABSTRACT

Heat localization has been proposed as a new strategy to utilize solar energy efficiently. In the past few years, extensive research on heat localization has been limited to solar-steam generation. Many devices have been designed to improve the efficiency of photothermal conversion, but the complex preparation processes and the cycle instability limit its large-scale practical application. Herein, we fixed reduced graphene oxide and silver nanoparticles on a melamine sponge skeleton by a simple coating method. The modified sponge retained the high porosity of the sponge substrate and exhibited photothermal properties and hydrophobicity. Consequently, the modified sponge showed a high solar-steam evaporation efficiency (86.8%) under one-sun irradiation and an excellent adsorption capacity to organic solvents and low viscosity oils (54.0–123.0 g/g). The modified sponge also reduced the viscosity of the heavy crude oil under the driving of solar energy to achieve a high adsorption capacity of heavy crude oil (68.0 g/g under one sun). Because of the excellent mechanical properties of the melamine sponge substrate, the modified sponge had great reusable performances, and met the simple and scalable manufacturing requirements in practical applications. This material provides a new idea for the recovery of heavy crude oil and provides new applications for photothermal-conversion materials.

KEYWORDS

Heat localization; Solar-steam generation; Oil adsorption; Graphene; Silver nanoparticles; Sponge

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