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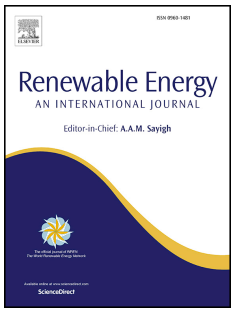

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Graphite/diamond ethylene glycol-nanofluids for solar energy applications

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Abstract

The rapid development of thermodynamic solar systems requires increasingly efficient absorption materials. This work reports on the investigation of light-intensity dependent optical properties of graphite/nanodiamond suspensions in ethylene glycol, in the perspective to evaluate their potential for direct absorption solar collectors and solar vapor generation. The study was carried out two sample types, differing in the ash content (0.3% and 5.9% wt in the powder), and at three concentrations each (0.0025%, 0.0050%, 0.0100% wt in the fluid). A high sunlight extinction was found, with full absorption in 15 mm and 30 mm path lengths for the 0.0100% and 0.0050% wt concentrations, respectively. This makes investigated nanofluids appealing as volumetric direct solar absorbers in solar collectors. Moreover, by characterizing optical properties at high incident intensities, we proved the creation of vapor bubbles in the base fluid via optical limiting effects active at least from ultraviolet to near infrared wavelengths. This result propose graphite/nanodiamond-based suspensions for sunlight-induced vapor generation application as well.

Keywords: Carbon, graphite, nanodiamond, nanofluids, optical properties, solar energy, optical limiting.

Introduction

Conventional solar collectors operating at low-mid temperatures consist of a sunlight absorbing coating deposed on a solid surface which exchanges heat with a working fluid. Energy losses due to thermal re-radiation by the heated absorber are typically reduced by a vacuum insulation of the absorbing surface. This scheme can be significantly simplified by the use of a dark fluid working both as volumetric light absorber and heat exchanger. In 1975 was launched the first idea of a direct-absorption solar collector (DASC) using a black liquid [1]. However, the India ink-based fluid investigated in that work was not