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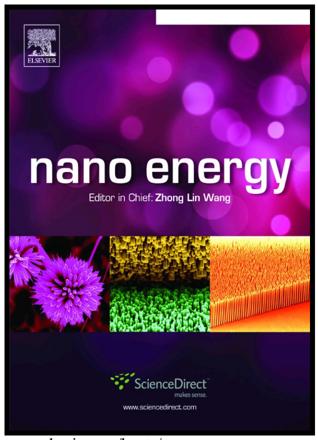

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Thermionic emission via a nanofluid for direct electrification from low-grade heat energy

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Abstract

Thermionic emission is the thermally induced flow of charge carriers over a surface work function or across an interface potential barrier. Historically this effect is used for energy generation by employing a thin vacuum or (more often) plasma gap between a hot cathode and a colder anode, across which charges are transferred. The magnitude of the charge flow increases with the cathode temperature, however only becomes significant above $\sim$1000 K thus limiting practical uses of thermionic energy generators (TiEG). Here we show that infilling a nanofluid inside the inter-electrode gap raises thermionic emission rate enormously, such that considerable currents can be generated even at room temperature. The nanofluid TiEG's output current density surpassed that of conventional TiEG, predicted by the fundamental Richardson-Dushman law, by factors of 40–60 orders of magnitude across the measured temperature range. This implies an enhanced thermionic emission via the nanofluid other than the conventional TiE, and may open up a novel pathway for thermally induced electrification.

1 Introduction

Efficient use of energy and searching for new power sources while keeping the environment benign are among the globally most crucial efforts of our era [1, 2, 3, 4, 5]. As a part of those, attentions are being paid for heat from natural resources and untapped amount, currently being wasted in many areas and activities ranging from production to transportation. Sufficiently exploiting these