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An Isothermal Device Configuration for Diamond Based Photon-Enhanced Thermionic Solar Energy Conversion[1] TIANYIN SUN, FRANZ KOECK, ROBERT NEMANICH, Department of Physics, Arizona State University
— Diamond can obtain a negative electron affinity (NEA) after hydrogen termination. With NEA and n-type doping, a low effective work function and efficient thermionic emission has been observed from these diamond films. Photo-induced electron emission from nitrogen doped diamond with visible light illumination has also been established by our group. Recently several reports have described efficient energy conversion based on the photon-enhanced thermionic emission (PETE) mechanism. This study proposes a multi-layer emitter and collector structure for an isothermal PETE converter. The emitter structure is based on an n-type NEA diamond film deposited on a p-type Si substrate to enable electron emission across a vacuum gap. In this structure the above-bandgap light is absorbed in the Si and establishs an enhanced electron population for emission through the low work function surface, while sub-bandgap light is absorbed in the collector for transfer to a heat engine. Spectroscopy measurements of the n-type diamond on Si indicate strong electron emissivity with photon illumination, and the emission intensity is significantly increased at elevated temperatures. A simplified model describing the efficiency and performance of an isothermal PETE device is presented.

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