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Alpha-Energy-Deposition-Profiling of Radioisotope $p-i-n$ Diodes for Power Generation CORY CRESS, RYNE RAFFAELLE, NanoPower Research Labs, R.I.T. — The high energy density and long half-life of certain alpha-emitting radioisotopes enables viable and long-lived power supplies to be fabricated on the micro-scale. A design incorporating an InGaP $p-i-n$ photovoltaic (PV) device that directly converts the kinetic energy of the alpha-particles into electricity represents both a scalable and efficient microsystem design. To better understand the relationship between the alpha-energy-deposition-profile (ADEP) and the maximum power conversion efficiency for this device structure, we have performed two systematic studies. In these studies, I-V characteristics for the InGaP PV device under alpha-flux are measured as a function of alpha source distance, and as function of aluminum film thickness (10 nm to 10 μm) which is deposited onto the surface of the PV device. Both techniques will alter the ADEP in relation to the active region of the PV device. These experimental results are compared to a theoretical model which utilizes Monte Carlo simulations and numerical calculations to determine the ADEP for the same device configuration. The understanding gained from this analysis has direct implications towards the fabrication of radioisotope microbatteries with structural characteristics that enable optimal power conversion efficiencies to be achieved.

Ryne Raffaelle

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