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Project Title.

Materials development for combined neutron and alpha voltaics

Abstract.

The goal is to develop solid-state neutron and alpha voltaics, which provide both direct electric power generation and neutron radiation shielding at low cost using hydrogenated boron carbide semiconductors. A neutron voltaic creates voltage and current pulses from neutron absorption, much like a photovoltaic. Designing and testing a combined neutron and alpha voltaic device with efficient radiation capture and charge extraction, for the highest possible power product, requires exploring both diode and transistor geometry. This is because an alpha voltaic will work best in transistor geometry due to small penetration depth of alpha particles. The project exploits the strengths of Robert Streubel in device fabrication and frequency-dependent electronic transport and decades of boron carbide device development at the University of Nebraska. It includes materials synthesis, device integration, radiation testing, and optimization. The investigators seek to establish the foundations for neutron and alpha voltaics research, including the demonstration of significant zero-bias currents under neutron and alpha radiation, to become competitive for funding from the Office of Fusion Energy Sciences (OFES) within the U.S. Department of Energy (DOE) and to position the University of Nebraska for the anticipated Rads to Power (R2W) solicitation (DARPA-SN-25-78) from the Defense Advanced Research Projects Agency (DARPA) Defense Science Office (DSO). The team will refurbish an existing deuterium and tritium (D-T) neutron source, at the University of Nebraska, to offer in-house capabilities for the characterization of neutron and alpha voltaics in the Laboratory of Robert Streubel.