Optimizing Neutron Production Rates from D-D Fusion in an Inertial Electrostatic Confinement Device

R.F. Radel, A.L. Wehmeyer, and G.L. Kulcinski

Fusion Technology Institute
University of Wisconsin
Madison, WI
kulcinski@engr.wisc.edu

Detection of explosives has been identified as a near term commercial opportunity using a fusion plasma. Typical explosive compositions contain low Z material (C, N, O) which are not easily detected using conventional x-rays or metal detectors. However, 2.45 MeV neutrons produced in a D-D fusion reaction can be used for explosives detection in suitcases, packages, shipping containers, or other clandestine materials.

Steady-state D-D operation is possible using Inertial Electrostatic Confinement (IEC) fusion. The University of Wisconsin IEC device has produced D-D neutrons at 1.8×10^8 neutrons/second at a cathode voltage of 166 kV and a meter current of 68 mA. These neutron production rates are approaching the levels required for the detection of explosives. In order to increase and optimize the neutron production rate in the IEC device, experiments were performed to determine the affect on the neutron production rate by altering the cathode's size (diameter), geometry, and material composition. Preliminary results indicate that significant differences in neutron production rates are not achieved by altering the geometry or material composition of the cathode. However, the neutron production rate was found to increase approximately 20% by doubling the cathode's diameter from 10 cm to 20 cm. In addition, increasing the cathode voltage from 34 kV to 94 kV at a meter current of 30 mA increased the neutron production rate from 1.24×10^6 n/s to 2.83×10^7 n/s.