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Discharge in the Trumpet Regions of the CANREB EBIS

Under operational conditions, high-voltage breakdown continues to occur inside the electron beam ion source (EBIS) at CANREB (the CANadian Rare isotope laboratory with Electron Beam ion source). Discharge tracks along components inside the high-vacuum together with data acquired during use of the system have isolated the most serious discharges to the collector trumpet (CT) region for a relatively narrow combination of high magnetic field (ca. 3 Tesla), high-voltage (ca. 10 kV applied to the drift tubes), and variable vacuum conditions. Recent tests indicate similar discharges are occurring around the gun-trumpet (GT) region. Penning or magnetron discharge were proposed to be involved, however, a clear understanding of the active processes and their interdependences remains obscure. Here we use OmniTrak (3D) to simulate the electric and magnetic field environment inside the EBIS, to better quantify the nature of the chronic discharges and their underlying mechanisms. E and B fields and electron motions are simulated around surfaces where the most serious damage occurred in the CT region. Effects of the 40K stainless-steel heat shield (at ground potential) surrounding the CT electrode (at high voltage) are simulated, because recent removal of this shield was found to reduce the severity of discharge. Different geometries of this 40K heat shield are simulated to determine the impact on the fields and electron motion in the CT region. This work aims to provide insight to the discharge mechanisms, so that the EBIS may be restored to full specs for creation and delivery of highly charged ions for nuclear astrophysics experiments at TRIUMF.

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Yes

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