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Operation of a high-voltage, high-power gaseous electronics switch for electric grid power conversion[1] TIMOTHY SOMMERER, SERGEY ZALUBOVSKY, General Electric Research, Niskayuna, NY — A series of approximations and simple models is used to estimate the properties of a cold-cathode plasma in a high-voltage, high-power gas switch for use in grid-scale electric power conversion. The active volume is a plane-parallel gap $\sim$ 1 cm filled with hydrogen at a pressure $\sim$ 0.3 torr. A magnetic field in the region adjacent to the cathode is used to increase the current density to practical levels >1 A/cm^2. The estimated bulk plasma density is mid-10^{12} cm^{-3} and the electron temperature is $\sim$ 3 eV, to offset volume recombination. The magnetic field enhances ionization near the cathode and also impedes electron diffusion away from the region, sometimes resulting in a peak of plasma density in an extended presheath region. The switch is opened by applying a positive potential to a grid between the cathode and anode, leading to the formation of an ion matrix sheath around the grid, and an ion-acoustic wave that sweeps out the conducting plasma between the grid and the anode in about 1 μs.

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