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First-principles model of electrode plasma formation in MA-scale accelerators

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Multi MA-class accelerators, such as Sandia National Laboratories' Z Machine, operate at such high energy densities that plasmas rapidly form on the electrode surfaces. These plasmas could expand sufficiently to reduce the transmission line impedance below the expected MITL operating value and may divert power from the load. Recent models of the Z Machine include plasma formation, in addition to electric-field-stress and thermal emission, however the plasma is assumed fully ionized upon desorption from the electrode [Phys. Rev. AB 22, 070401 (2019)]. To test the validity of this assumption, we perform kinetic simulations of the desorption of neutral surface contaminants and their subsequent dissociation and ionization. Experiments indicate that the main surface contaminants are CO, H_2O, H_2, and CO_2 [Phys. Rev. ST-AB 20, 010401 (2017)]. The processes modeled are dissociation, electron impact and thermal ionization, charge and momentum exchange, and attachment. Preliminary results for the formation times and distributions of electrode plasmas at the MA scale will be presented.

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