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High-pressure plasma source development through time-resolved diagnostics, PIC and global simulations[1] GUNSU YUN, MINUK LEE, WOO-JIN NAM, SEOK YONG JEONG, SEUNGTAEK LEE, JUHO LEE, JIMO LEE, JAEMIN YOO, JAE KOO LEE, Pohang University of Science and Technology — High-pressure plasmas are an interesting state of matter where transport phenomena occur among multiple species (electrons, ions, neutrals, and cluster ions). Development of efficient high-pressure plasma source requires understanding of the energy transport process from external power source to electrons as well as internal transport processes among different species. In particular, confinement of electrons and energy transport from excited heavy species are critical for sustainment of the plasma state. Motivated by experimental findings of higher densities excited species in microwave driven plasmas, recent particle-in-cell (PIC) simulations on micro-sized (0.1–1 mm) high-pressure gas discharge between planar electrodes driven by microwave ($\sim$ 1 GHz) showed that the electron confinement is substantially enhanced above a critical frequency. In addition, time-resolved measurements, PIC and global simulations showed that the generations of energetic electrons and reactive species are enhanced by pulsed microwave operation. A general rule of thumb design principles for the optimization of high pressure plasma sources has been deduced from the perspective of external power coupling and internal energy transport.

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