Magnetic enhancements of ion densities effusing from a low power atmospheric pressure Ar plasma

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Tungsten inert gas employs magnetic field using permanent magnets and electromagnets to increase power density, enhance temperature distribution, and improve the performance in plasma arc welding. In general, addition of magnetic field could enhance plasma characteristics due to magnetic confinement by the Lorentz force, and plasma expansion and diffusion in a magnetic field according to Ohm's law. Although the effect is complex in atmospheric plasma due to short mean free path, increase in the total ion density and specific ion density of each ion species were observed using 86 Gauss Neodymium permanent magnet shown in Figure 2. Theoretically, the magnetic field intensity B should exceed $(m\mu_e E)/(e\lambda_e)$ to be significant for an electron trajectory in atmospheric pressure plasma where m is mass of electron, e is electron charge, λ_e is mean free path, μ_e is mobility of electron and E is local electric field. By varying magnetic field of permanent magnets and electromagnets, magnetic enhancement of ion densities effusing from low power atmospheric pressure Ar plasma.

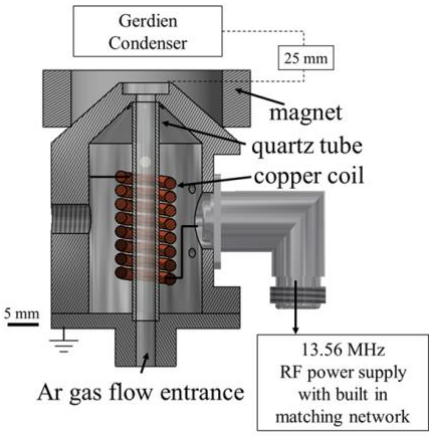

Figure 1. Setup for the magnet coupled with atmospheric pressure plasma and Gerdien condenser.

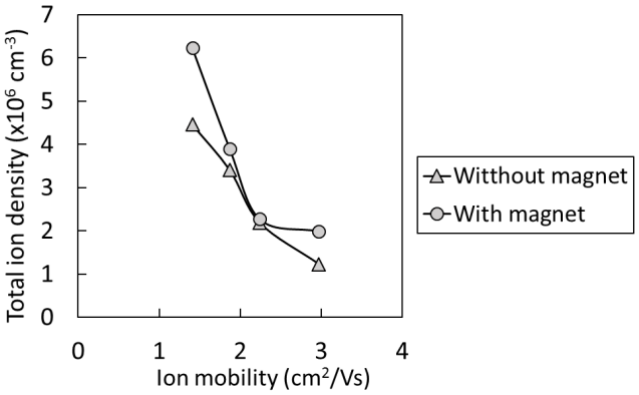

Figure 2. Magnet enhancement of ion density of Ar atmospheric plasma measured using Gerdien condenser.