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Research progress on the characterization and modulation of high-pressure gas discharge plasmas

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As the fourth state of matter, plasma can be considered as both a particle assembly and an energy carrier. There exist non-equilibrium synergistic mass-momentum-energy exchanges (MMEEs) in high-pressure gas discharge (HPGD) plasmas arising from frequent collisions among various species [1]. From the aspect of applications, modulation of the key plasma parameters, i.e., translational temperatures of electrons and heavy particles, number densities of chemically reactive species, are of crucial importance facing different applications, e.g., synthesis of advanced nano-scale structured materials, plasma medicine and genome mutation breeding of organisms [2-4]. In this paper, the analysis on the synergistic MMEEs in some typical HPGDs including the free-burning argon arc plasmas [4] and radio-frequency atmospheric-pressure glow discharge plasmas [5], using the central concept of “Energy Tree” [1] are presented. The discussions on the future studies for developing the precision plasma technology are also discussed.

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