Electronimpact excitation diagnostics in pulse-modulated Ar/O_2 inductively coupled plasma

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An intensified charge-coupled device (ICCD) camera is applied to investigate the electron excitation dynamics of Ar ($2p_1$,with emission line of 750 nm) in pulse-modulated radio frequency (rf)Ar/O_2 inductively coupled plasmas (ICPs). Since the electron impact excitation rate has two excitation maxima within a rf cycle during H-mode in ICPs, whereas only an excitation maximum appears in E-mode, the time of the E-H mode transition and the spatial-temporal distributions of the electron excitation rate during the H-mode and a whole pulse period are investigated in nanosecond resolved pulse-modulated rf Ar/O_2 ICPs. It is founded that with the increase of the duty cycle/pressure, the time of the E-H mode transition at the initial active glow decreases, while it increases with the source power increasing. Therefore, the capacitive coupling (E-mode) at the initial pulse duration can be weakened by adjusting the discharge parameters. In addition, itis founded that as the O_2 content/pressure increases, the distribution of electron impact excitation (within a rf cycle during theH-mode) in z-axis concentrates closer to the quartz window. Meanwhile, the bimodal structure of the electron excitation within a rf cycle becomes more prominent at larger O_2 content/higher pressure. Besides, it is found that as the pressure/O_2 content increases, the appearance time of the electron excitation maximum at the initial pulse in a whole pulse period is shortened, while it is prolonged with the discharge power increasing.

This work is financially supported by the NationalNatural Science Foundation of China (NSFC) (Grand No. 11675039),the Fundamental Research Funds for the CentralUniversities (Grand No. DUT16LK06), and the ImportantNational Science and Technology Specific Project (Grant No. 2011ZX02403-001).