Effects of temperature gradient by chemical reactions in Ar/H_2 inductively coupled plasma using fluid simulation

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The neutral gas temperature in plasma sources is one of the important plasma parameters because this is associated with neutral gas density. In general low-temperature plasma simulations without another heat sources, neutral gas temperature is usually fixed at constant. However, continuous chemical reactions such as dissociation, recombination, and excitation take place in plasma, which affects the neutral gas temperature in the plasma chamber.

In this study, a fluid model of 2D axis-symmetry in an inductively coupled plasma (ICP) reactor using Ar/H2 gas mixture has been developed. Driving frequency was 13.56 MHz and input power was fixed at 1000 W. The diffusion coefficient of heavy particles and source gases density were changed by the temperature change in the chamber. As a result, different distributions of electrons, ions, and molecules generated by chemical reactions were observed. Also, the effects of gas pressure and the gas mixture ratios have been analyzed comprehensively in this simulation conditions.