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Modeling and experiment of ring-shaped emission profile in plasma bullet YUKINORI SAKIYAMA, DAVID GRAVES, University of California at Berkeley, JULIEN JARRIGE, MOUNIR LAROUSSI, Old Dominion University — Our recent measurement demonstrated that a plasma "bullet" at atmospheric pressure shows ring-shaped emission profile. In this study, we focus on the mechanisms of the ring-shaped profile by means of finite element method and spectroscopic measurement. Our model is based on a fluid model with the local field approximation in 1D cylindrical coordinates, corresponding to a cross section of a plasma bullet. An expected concentration gradient of humid air is assumed to be present due to diffusion of air. Pulse-like electric field is given perpendicular to the simulation domain. Our simulation results show that the major ionization reaction is Penning ionization between nitrogen (air) and helium metastables. The density of electrons and positive nitrogen ions show the peaks near the outer boundary due to the higher concentration of air there. Accordingly, the emission peak appears near the outer boundary, corresponding to a ring-shaped emission profile. Experiments were performed with a dielectric barrier discharge reactor driven by high voltage short rise time pulses. Radial profile and time-resolved OES of radiative species were compared to simulation results.

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