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Numerical analysis of surface dielectric-barrier-discharge and gas heating effect for application of aerodynamics SHINTARO SATO, MASAYUKI TAKAHASHI, NAOFUMI OHNISHI, Tohoku University — Active flow control techniques using dielectric-barrier-discharge (DBD) have been studied by many researchers as DBD plasma actuators. We have conducted three-dimensional fluid-discharge coupling simulation in this study in order to investigate the discharge process and the induced flow field in the nanosecond-pulse-driven DBD plasma actuator. The similar current waveform was obtained between the two- and three-dimensional simulations; however, the discharge has non-uniform structure in span-wise direction as observed in previous experimental study. A filamentary discharge, which has branching streamers, is obtained in the positive-going phase of the applied pulse. In the negative-going phase, the discharge process depends on the dielectric-surface charge deposited during the positive-going phase. The spherical shock waves generated from small cusps of the exposed electrode are reproduced, indicating that this complex pattern imposes the three-dimensional perturbation on the ambient flow. We are going to discuss the gas heating process by considering the detailed process of the energy transfer into the translational energy of the neutral particles and the effect on the flow control performance.

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