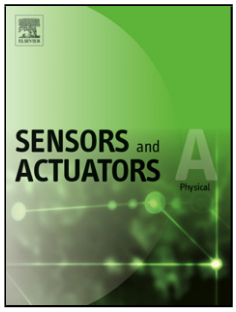


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# Influence of Capacitor Energy on Performance of a Three-electrode Plasma Synthetic Jet Actuator

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**Abstract: The influence of capacitor energy on characteristics of a three-electrode plasma synthetic jet actuator (PSJA) is experimentally investigated by schlieren method. Jet duration time and jet affected area are extracted by image processing. As normalized capacitor energy increases from 0.044 to 22.1, three flow field evolution patterns are presented. In the first pattern, only shock wave can be observed while no fluid is expelled out. In the second pattern, the jet is thin and weak, with a vortex pair ahead of it. The last pattern is characterized by a strong and bright jet. With capacitor energy increasing, peak jet front velocity increases proportionally on semilog coordinate, with a maximum of 230 m/s, while both maximum jet affected area and jet duration time first go up and then keep almost constant.**

**Key words: plasma actuator; synthetic jet; capacitor energy; characteristic**

## I. INTRODUCTION

Plasma flow control has a promising and wide application prospect in lift augmentation, drag reduction, shock wave manipulation, compressor stability extension and so on [1]. The core of plasma flow control technology is the plasma actuator. As a new-type plasma actuator, plasma synthetic jet actuator (PSJA) integrates abundant advantages including high exhaust velocity, non-moving parts and fast response [2]. Investigation on PSJA characteristics is essential to better understand the flow control mechanism and improve flow control performance.

PSJA can be roughly divided into two types, the traditional two-electrode and novel three-electrode configuration. Compared with the former, the latter has a lower requirement on anode voltage due to the addition of trigger electrode [3]. Thus, a large extension of capacitor energy can be realized by the three-electrode PSJA. Factors affecting the actuator performance include the geometrical parameters (orifice diameter, volume, ratio of height to diameter and so on) and actuation parameters (energy deposition, discharge voltage, frequency and so on). Results from high speed schlieren images, dynamic pressure measurement and simulation indicate that a larger orifice results in a higher total impulse but shorter jet duration. Increasing the cavity volume leads to the drop of total impulse, as well as the jet velocity [4-9]. Performance comparison of the capacitive and inductive power supply shows that the higher energy deposition rate of capacitive power supply induces a higher velocity but lower duration jet [10]. With the increase of the frequency, the jet Mach number goes down and an occasional absence of pulsing may occur at frequency higher than 5 kHz [11-14]. As for the energy deposition, it is experimentally observed that with the capacitor energy rising, both the jet velocity and the total impulse increase