# Optical wave microphone measurements on pressure waves emitted from plasma jets

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The aim of this research is to detect pressure waves that are emitted from plasma jets using an optical wave microphone technique and to analyse the frequency relationship between pressure waves and applied voltage waveform.

## 1. Introduction

Plasma jets have been expected to be used in various applications such as biomedical usage. There have been many reports on electrical and optical measurements about plasma jets. One of the important observations from practical point of view on what plasma jets emit is pressure waves because pressure waves can directly influence on targets or penetrate into liquid, tissues, and so on.

In this work, we utilized a fibered optical wave microphone, which works based on Fraunhofer diffraction of phase objects and improves upon a conventional optical wave microphone with regard to signal-to-noise ratio, to detect pressure waves generated inside He plasma jets with the electrode configuration of dielectric barrier discharge. The frequency of applied voltage dependence on the generation of pressure waves from plasma jets was investigated in different He gas flow rates. The distribution of pressure waves along radius direction of plasma jets at different distances downstream from the tip of the device was also discussed.

## 2. Results and discussions

It was obvious from the optical wave microphone measurement that pressure waves are emitted from plasma jets. Figure 1. shows the detected signals of pressure waves and its intensity distribution inside plasma jets operated at frequency of 2.8 kHz and 7 L/min. of He gas. The position of a series of the measurements was 5 mm downstream from the tip of a glass tube. The width of the pressure waves in He jet was estimated to be approximately 3 mm which corresponded to that of plasma plume. The pressure waves were completely degenerated and some pressure changes such as turbulence was detected at 20 mm downstream from the tip although plasma jet can be observable clearly at the position.

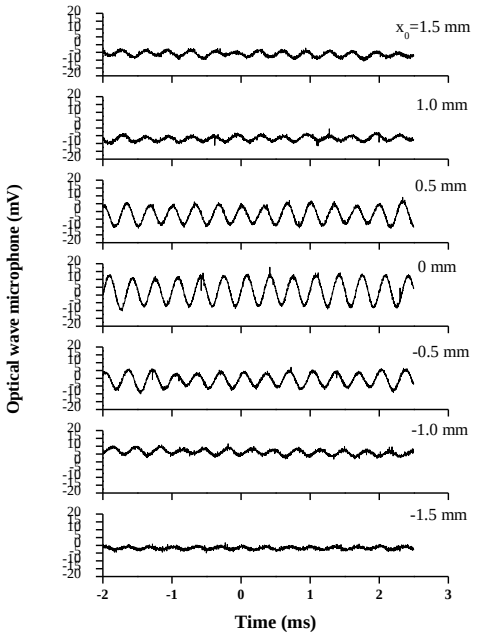


Fig. 1 Waveforms of detected pressure waves at different positions along radius direction. Plasma jets were operated at frequency of 2.8 kHz and 7 L/min. He gas.

## 3. Summary

Pressure waves were detectable with the optical wave microphone inside the plume of plasma jets.

## 4. References

[1] F. Mitsugi, T. Nakamiya, Y. Sonoda, T. Kawasaki, IEEE Trans. Plasma Sci., **44** (2016) 2759.
[2] F. Mitsugi, S. Kusumegi, T. Kawasaki, T. Nakamiya, Y. Sonoda, IEEE Trans. Plasma Sci., **44** (2016) 3077.