

THE ACOUSTIC SIGNAL MEASUREMENT AND ANALYSIS IN ATMOSPHERIC PRESSURE PLASMA

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Abstract. We have previously succeeded in measuring the acoustic signal detected by the condenser microphone due to the dielectric barrier discharge and discriminating the dominant frequency components of the acoustic signal. The dominant frequency components appear over 20kHz of acoustic signal by the dielectric barrier discharge. In this paper, Measurement of sound wave is examined by the light diffraction effect of a visible laser beam. This method is useful to detect the acoustic signal generated by the electric discharge.

1. INTRODUCTION

The research of the positive use and application about micro discharge have been performed including the removal of the environmental pollutant such as NO_x, ozonizer, plasma display and the further applications are expected[1,2]. The phenomenon clarification of micro discharge chiefly examines the voltage, the current, and luminescence. When the discharge occurs in dielectric materials such as air, the sound and ultrasonic waves are produced by an energy release. The sound signal is useful to detect the discharge state [3,4]. However, the example of using the electrical discharge sound is not seen as a means of the phenomenon clarification. To examine the fundamental characteristic of micro discharge, the voltage, the current, and the electrical discharge sound are measured, and examined the fundamental relationship between the micro discharge and the acoustic properties.

However, the sound in plasma reactor is impossible to detect by the condenser microphone technique. Therefore, we have attempted to develop a new diagnostic method (optical wave microphone), in which sound wave is measured by an optical sensor based on a diffraction effect [5-8] between the sound wave and laser beam. Light diffraction or scattering is very useful for the detection of an acoustic sound wave without disturbing the sound field. This method can be applied to diagnose the plasma state even during operation because this measurement system is totally insulated.

The Continuous Wavelet Transform (CWT) is applied to discriminate the acoustic sound of the micro discharge and the dominant frequency components. In addition, the energy distribution of the sound signal over the time-frequency plane is examined by the scalogram of CWT. CWT has better accuracy and precision than those obtained with the other time-frequency analysis method such as Short Time Fourier Transform (STFT)[9].

2. EXPERIMENTAL PROCEDURES

The creeping discharge is generated in order to understand the fundamental relationship between the micro discharge and the acoustic properties. Figure 1 shows the electrode, and the creeping discharges with a flat cable electrode on the dielectric material and with a plane backside electrode have been

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