

Effect of Electrode Configuration on Plasma Discharge Characteristics and PVDF Film Properties Using Atmospheric Pressure Plasma Jets

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The development trends of piezoelectric nanogenerators (PENGs) will be flexible light weight and wearable self-powered electronics for an industrial application. For this reason, polyvinylidene fluoride (PVDF) for piezoelectric polymer materials seem to be attractive candidates for flexible PENGs owing to mechanical flexibility and good properties of the piezoelectric and ferroelectricity [1,2]. Recently, these PVDF-based polymers are used to produce films using the various plasma techniques such as low-pressure and atmospheric pressure plasma (APP). In particular, the APP process is the appropriate method to deposit the polymer film on the point of view a simple and low cost process. This APP process are effective method for polymer deposition under ambient air due to easy, simple process, and room temperature [3]. There are few research on the piezoelectric polymers using the APP process [1,4]. However, there are some problems such as low deposition rate, loss of monomer precursor, and small deposition area of the APP processes. Thus, to resolve these problems, the structural improvement of plasma reactor is essential for enhancing the efficiency of deposition rate and deposition area.

Accordingly, this study investigates the plasma discharge characteristics and structural properties of PVDF thin film deposited by using APP reactor in terms of two different electrode configurations (metal-mesh and planar-type). The characteristics of PVDF thin films investigated using field-emission scanning electron microscope (FE-SEM), Fourier transforms-infrared spectroscopy (FT-IR), X-ray diffraction (XRD), and LCR meter. Through new APP plasma reactor electrode configurations, the thickness of PVDF thin film was increased by using a planar-type electrode compared to that of a metal-mesh type electrode at room temperature using a mixed polymer solution composing of PVDF nano powder and dimethylformamide solution. FE-SEM results show that PVDF nanoparticles are clearly observed and uniformly coated. In the FT-IR spectra, two types of chemical bonds (α and β phases) were observed in the deposited PVDF thin film. Based on these experimental results, we may expect that a new APP plasma reactor will be a great attractive method in order to synthesis the PVDF thin film under atmospheric pressure. The APP with new APP plasma reactor, FE-SEM, FT-IR, XRD, LCR meter, and related mechanism of PVDF thin film are studied and will be discussed in detail.

Keywords: Atmospheric pressure plasma (APP), polyvinylidene fluoride (PVDF) thin film, structural property

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