Dielectric Property on the Post-Heating Treatment of PVDF Thin Film Prepared by Atmospheric Pressure Plasma Deposition

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Recent developments of piezoelectric nanogenerators (PENGs) for industrial application, will be flexible and stretchable electronic devices with light weight. The piezoelectric polymers seem to be promising alternatives for flexible PENGs. In present, polyvinylidene fluoride (PVDF) has been widely used due to its unique properties such as mechanical flexibility, high chemical resistance, biocompatibility, and high temperature resistance [1,2]. However, this PVDF polymer has still lower piezoelectric characteristics when compared with piezoelectric ceramics. Thus, it is necessary to improve the piezoelectric and dielectric property of the conventional PVDF material for flexible PENGs. Many researches have been mostly investigated on the piezoelectric polymer-nanocomposites with nano-particles in order to develop dielectric materials with high dielectric coefficient for flexible PENGs [1,3].

Accordingly, we examine the effects of the post-heating on the structural and dielectric properties of PVDF thin film deposited by atmospheric pressure plasma (APP) system. The structural and dielectric properties of PVDF thin film were systematically investigated by using field emission-scanning electron spectroscopy (FE-SEM), X-ray diffraction (XRD), Fourier transforms-infrared spectroscopy (FT-IR), LCR meter according to post-heating in order to remove the N,N-dimethylformamide (DMF) element and enhancing the chemical structure of PVDF thin film. After post-heating treatment, the amount of bubble was reduced. This result implies that the DMF solution is almost removed from PVDF thin film, and the PVDF nanoparticles are clearly observed on the surface of PVDF thin film. In FT-IR, the peak intensity at 1669 cm^{-1} for -C=O by DMF solution largely decreases after post-heating, and the post-heated PVDF thin film shows mainly two crystalline phases (α and β phases), which represents the peaks at 975 and 1402 cm^{-1} for α-phase and the peak at 1072 cm^{-1} for β-phase, respectively. The formation of two phases (α and β phases) attributed to the increment in the dielectric constant of the post-heated PVDF thin film. The capacitance and dielectric coefficient values were measured to be 96 nF and 15 at 1 kHz frequency in post-heated PVDF thin film, respectively. The detailed characteristics of the post-heated PVDF thin film using FE-SEM, FT-IR, XRD, and LCR meter are under study and will be discussed in detail.

Keywords: Piezoelectric nanogenerators, PVDF thin film, atmospheric pressure, plasma deposition, post-heating treatment, dielectric constant

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