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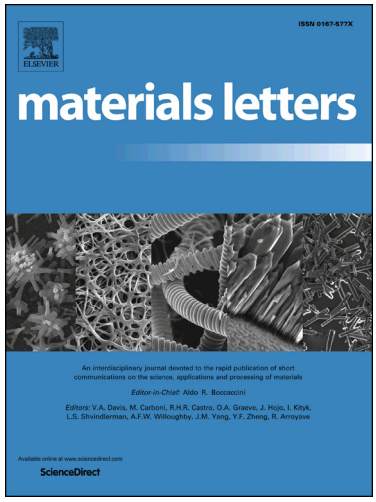

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The Impact of Solvents on Properties of Solution-cast Poly(vinylidene fluoride) Films for Energy Storage

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Abstract

The properties of solution-cast poly(vinylidene fluoride) (PVDF) films for energy storage are affected greatly by solvents used. In this letter, surface micrographs, crystalline phases, and energy storage properties of PVDF films crystallized from different solvents were studied. Under an electric field of 1000 kV/cm, the charge-discharge efficiency of the PVDF film crystallized from N,N-dimethylformamide (DMF) (with low vapor pressure) is 2.6 times higher than that of the PVDF film crystallized from N-methyl-2-pyrrolidone (NMP) (with high vapor pressure). Meanwhile, the resistivity of the former is up to 6.6 times higher than that of the latter.

Keywords: poly(vinylidene fluoride), solvent, vapor pressure, charge-discharge efficiency, resistivity.

1. Introduction

Over the past few decades, poly(vinylidene fluoride) (PVDF) has been extensively studied for its excellent electrical, chemical, mechanical and thermal properties.[1-3] Among numerous applications of PVDF, dielectric films for capacitors are one of its most promising applications.[4,5] To meet the cost and quality requirements, current commercial capacitor films are manufactured using different processes such as solution casting, melt extrusion and biaxial orientation, and more.[6,7] Among these preparation methods, the solution casting is the most effective and widely used method due to its little requirement of material (< 1 kg) and easy operation in laboratories.[6]

To obtain PVDF films with a specific microstructure at a controlled and reproducible condition, extensive research has been conducted recently. The effects of molecular weight of PVDF and its distribution[8], solvent type[9,10], concentration[11,12], temperature[12-14], humidity[15,16], substrates[15-17], and addition of PMMA[18] on the formation of solution-cast PVDF films have been studied. However, little is revealed about how to control electric properties of solution-cast PVDF films through properly choosing a solvent. Therefore, the relationship between manufacturing processes and properties of solution-cast PVDF films, especially the effect of solvent type on energy storage properties of films, needs to be studied.

In this letter, we report effects of solution casting processes, specifically the solvent type, on properties of solution-cast PVDF films for energy storage. The evaporation

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