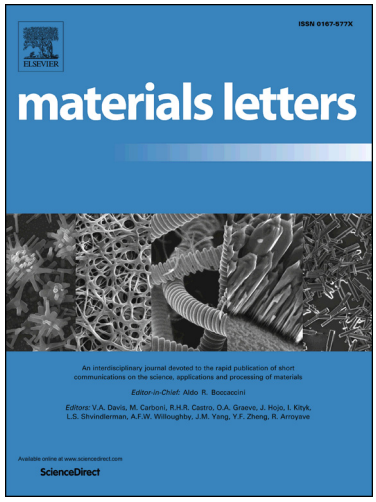

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Linear dependence between content of effective piezo-phase and mechanical-to-electrical conversion in electrospun poly(vinylidene fluoride) fibrous membrane

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Abstract

PVDF fibers were prepared via electrospinning with different electric field and rotating speed, respectively. The values of piezoelectric output of the devices assembled by PVDF fibrous membrane linearly fit with the product of the numerical values (C_{EP}, content of effective piezo-phase) of crystallinity and β-phase proportion in electrospun fibers. With the optimized parameters of electric field (15 kV) and rotation speed (500 rpm) in electrospinning, the maximal output of 2.8 V and 1.32 μA were obtained. The controllable crystal structure of PVDF and definite relationship between preparation parameters and piezoelectric behavior is beneficial for modulating the mechanical-to-electrical conversion in device.

Keywords: Electrospinning; Polymers; Piezoelectric materials; PVDF; Phase-structure; Fibrous membrane

1. Introduction

Due to excellent electroactive properties and good flexibility, the ferroelectric polymer polyvinylidene fluoride (PVDF) is much promising in fabricating piezoelectric applications and even wearable devices [1-6]. Generally, α and β are the dominant phases in solid-state PVDF, where molecular chains in α-phase arrange symmetrically as nonpolar structure and molecular chains in β-phase arrange asymmetrically as polar structure. Conventionally, mechanically stretching or corona/high-field poling is necessary as the post-treatment for driving part of α-phase convert to β-phase in as-casting film to obtain better piezoelectric response [7,8]. Some other contributions improved the piezoelectric property of PVDF