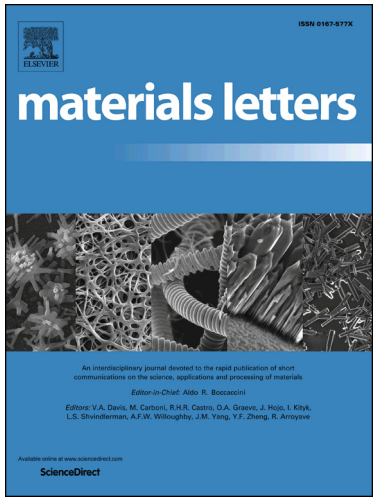

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Superior dielectric properties in $Na_{0.35\%}Ba_{99.65\%}Ti_{99.65\%}Nb_{0.35\%}O_3$/PVDF composites

Shuting Wang, Jie Sun, Lei Tong, Yuomin Guo, Hong Wang and Chunchang Wang*

Laboratory of Dielectric Functional Materials, School of Physics & Material Science, Anhui University,

Hefei 230601, China

Abstract

In this paper, the recently developed environmentally friendly lead-free ferroelectric $Na_{0.35\%}Ba_{99.65\%}Ti_{99.65\%}Nb_{0.35\%}O_3$ (NNBT) was firstly used as filler to synthesize ceramic-polymer composites using polyvinylidene fluoride (PVDF) as martix. The composites PVDF-*x*NNBT with different volume fractions of $x = 0$, 0.1, 0.2, 0.3, 0.4, and 0.5, were prepared via solution mixing and hot pressing method. Dielectric properties were investigated in the temperature range from room temperature to 250 °C and frequency range of 10^2 to 10^6 Hz. All the investigated composites show high dielectric constant (>100) and low loss tangent (<5%). The best dielectric properties were found in PVDF-0.5NNBT, which shows weakly frequency and temperature dependent dielectric constant of 220 and low loss tangent of 0.037 at 1 kHz. Interfacial relaxation arising from the ceramic-polymer interfaces was suggested to be the main reason of the superior dielectric properties.

Key words: PVDF polymer; ferroelectric ceramic; composite; dielectric constants; dielectric loss

*Corresponding author, Electronic mail: ccwang@ahu.edu.cn

1. Introduction

The ceramic-polymer composites (CPCs), prepared by dispersing ceramic powders into polymer matrix, combine the merits of ceramics and polymers and thus hold tremendous promise for a wide range of applications, especially for electric device miniaturization and energy storage [1]. High dielectric constant is a key requisite for these applications. However, dielectric constant of most CPCs is less than 50 even with the ceramic fraction reaching 50% [2]. To overcome this shortcoming, colossal dielectric constant ($\varepsilon' > 10^4$) ceramics, such as