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**Superior dielectric properties in  $\text{Na}_{0.35}\text{Ba}_{0.65}\text{Ti}_{0.99}\text{Nb}_{0.01}\text{O}_3/\text{PVDF}$  composites**

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**Abstract**

In this paper, the recently developed environmentally friendly lead-free ferroelectric  $\text{Na}_{0.35}\text{Ba}_{0.65}\text{Ti}_{0.99}\text{Nb}_{0.01}\text{O}_3$  (NNBT) was firstly used as filler to synthesize ceramic-polymer composites using polyvinylidene fluoride (PVDF) as matrix. 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  $250^\circ\text{C}$  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- $0.5$ NNBT, 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

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**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 ( $\epsilon' > 10^4$ ) ceramics, such as

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