Electrophoretic Deposition of Potassium Sodium Niobate Thick Perovskite Coatings for Energy Harvesting Applications

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Abstract

Globally, depleting non-renewable energy resources and environmental pollution are significant challenges. Researchers and scientists have recently turned their focus to perovskite coatings because they have the potential to replace green fuel production with maximum efficiency without environmental hazards. KNN ceramics are fabricated by solid-state method, calcined at 850 ℃, and electrophoreticcally deposited on Ni-substrate uniquely then, sintered at high temperatures. The X-ray diffraction and FTIR confirmed the development of a pure KNN perovskite structure and metallic bond groups (-O-Nb-O) present in the coating, respectively. The sintering temperature resulted in the pronounced peaks observed in KNN ceramics, confirmed by Raman spectroscopy, and easily observed in SEM having "square" and "circular" morphology with grain growth. The coating thickness was measured around 120 µm with increasing deposition rate (0.40 µm/sec) was calculated. The coating roughness (~813 nm) was confirmed by atomic force microscopy. Complex impedance spectroscopic (CIS) analysis confirmed the high dielectric constant (~4789) with a high transformation and curie temperature ($T_{O\rightarrow T}$ ~ 280 ℃ & T_C ~ 480 ℃), respectively. The increasing conductivity (≥830 µS/m) at higher frequencies and temperatures agrees with the hopping conduction mechanism, which confirmed the negative temperature coefficient of resistance (NTCR). This work holds great significance in photovoltaics, sensors, actuators, spintronics, and energy harvesting applications.

Keywords

Perovskite, Electrophoreticcally, Dielectric, Sensors, Actuators, Spintronics

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