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Electro-responsive material based on plasticized poly(lactic acid) and graphene nanoplatelets as a fillers

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Poly(lactic acid) (PLA) is an attractive candidate for replacing petrochemical polymers because it is biodegradable and can be derived from renewable resources. The main problems of PLA have been its brittleness and toughness that limit many commercial applications. The use of a plasticizer is one way to enhance flexibility and ductility of PLA matrix. Moreover, the combination of PLA with nano-sized particles such as carbon-based nanoparticles can be expected to improve the properties of PLA. In this work, poly(lactic) acid (PLA) films, incorporated with graphene nanoplatelets as fillers and dibutyl phthalate (DBP) as a plasticizer were prepared by solvent casting method. All composites possessed good electromechanical recoverability during the temporal response experiments under applied electric field. The 0.1%v/v MG/PLA/DBP composite showed the highest storage modulus sensitivity at the electric filed strength of 1.5 kV/mm. At the graphene concentration of 1.0%v/v, the storage modulus response (ΔG□) became negative definite, where the storage modulus under electric field (G') was lower than the G□0 value. The negative ΔG under electric field at room temperature has not been previously reported for any electrosrictive materials. Moreover, the pristine PLA/DBP showed the highest deflection distance relative to the composites at the electric filed strength of 550 V/mm; the deflection distance of the composites decreased with graphene concentration.

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