



Measurement of flexoelectric coefficient in the relaxor ferroelectric terpolymer Poly(vinylidene-trifluoroethylene-chlorofluoroethylene)

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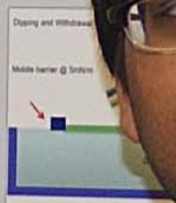
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INTRODUCTION

Traditional electromechanical phenomenon, piezoelectricity has been widely studied in piezoelectric materials. However, an unconventional electromechanical phenomenon known as flexoelectricity where strain effects the polarization in a way similar to an applied electric field. [1,2] Flexoelectric coupling between strain gradient and electrical polarization is present in all piezoelectric materials, however, separation of piezoelectric and flexoelectric signals is challenging, because the piezoelectric signal dominates the measurement. In this work, we develop an approach to measuring the flexoelectric coefficient of the polarization induced for a given strain gradient. We use a technological estimate [3] of the flexoelectric coefficient for crystalline materials (the electric charge to the lattice constant (e/a), which is of the order of 10^{-11} C/m. We report a study of the flexoelectric effect in ferroelectric copolymer poly(vinylidene-trifluoroethylene), P(VDF-TrFE) and a relaxor terpolymer variant poly(vinylidene-trifluoroethylene-chlorofluoroethylene) (P(VDF-TrFE-CFE)). [4]

EXPERIMENTAL APPROACH

Langmuir-Blodgett films of the ferroelectric copolymer PVDF-TrFE (70:30) [5] and terpolymer P(VDF-TrFE-CFE) (55.8:35.9:2) were fabricated using the horizontal Schaeffer technique. The polymer layer was dispersed on a sub phase of di-methyl sulfoxide as well as di-methylformamide.

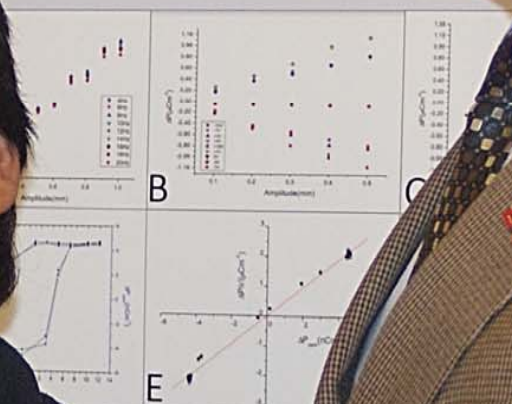


Surface pressure of 5 nN/m by touching the surface of ultrapure water. After that the sample at 135 °C.

RESULTS AND DISCUSSION

- The change in film polarization due to the piezoelectric and flexoelectric contributions is given by $\Delta P_p = d \cdot \epsilon$ and $\Delta P_f = \mu \cdot \epsilon'$ where P is polarization, d is the piezoelectric coefficient, ϵ is the strain, μ is the flexoelectric coefficient, ϵ' is the strain gradient.
- In case of the ferroelectric copolymer the polarization state was measured as grown unpoled state as well as after poling at different temperatures. (The net polarization change is proportional to polarization.) The net polarization change is given by $\Delta P = \Delta P_p + \Delta P_f$ where κ is a constant and P_r is the remnant polarization. The intercept gives an upper limit for μ .

RESULTS FOR THE FERROELECTRIC COPOLYMER P(VDF-TrFE)



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