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Measurement Techniques for Direct and Converse Piezoelectric Responses in Fluid Ferroelectrics

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Piezoelectricity, a linear electromechanical coupling between electric and mechanical signals, is a well-known phenomenon in solid materials. Piezoelectric phenomenon can be observed in two ways: (1) the direct effect, when an exerted stress on the sample induces electric charges and (2) the converse effect, when an applied voltage on the sample induces deformation. The discovery of ferroelectric nematic liquid crystals revealed a new 3D fluid material group with a symmetry that allows the presence of piezoelectricity [1]. Understanding the effect in ferroelectric fluids may enable the development of flexible, self-healing piezoelectric chips that can be used for energy harvesting, in micro-positioners and actuators.

While the techniques to measure the piezoelectric properties of solid materials is well-established, quantitative characterization of piezoelectric liquids requires different approaches with new challenges [2]. In the presentation, we will show a new experimental device suitable for quantitative measurements of both the direct and the converse piezoelectric effects in liquids in a broad temperature range. We compare the piezoelectric coupling constants for various different materials and polar phases. We also show how to boost the effect with external electric fields or by modifying the measuring geometry.

References

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