Flexoelectricity

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Flexoelectricity is a coupling between electric polarization and strain gradient. In layman's terms, it's the ability of materials to generate a voltage upon bending –or, conversely, to bend when a voltage is applied to them. By symmetry, it is allowed in ALL materials. In practice, in order to generate measurable flexoelectric effects one needs very large strain gradients and/or very large flexoelectric coefficients, which are not so easily encountered.

In recent years, flexoelectricity has gone from an obscure academic curiosity to something approaching the mainstream, thanks to the discovery that (i) enormous strain gradients can be achieved easily at the nanoscale, and (ii) besides "conventional" flexoelectricity, there are several other mechanisms that can provide flexoelectric-like responses with coefficients far exceeding the classical limits. The universality of the phenomenon is also contributing to its popularity, having now been identified in dielectrics, semiconductors, electrets and even biomaterials such as bones. A final and very important feature of flexoelectricity is that its symmetry constraints are very different from those of piezoelectricity, so it can act not just as a substitute for it but in fact it can enable new physical responses that cannot be achieved by any other means.

In this lecture, I will describe what is flexoelectricity, in what materials is it largest and why. I will also explain why the symmetry of flexoelectricity enables fundamentally new physical effects, and give real examples of such phenomena.