

Superconductivity and Ferroelectricity

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Superconductivity and ferroelectricity appear at first sight as mutually exclusive phenomena. Indeed, the local electric fields generated by the dipoles at the heart of ferroelectricity should be screened by conduction electrons. Therefore, ferroelectrics and conductive materials should compose two non-overlapping sets of materials. The incompatibility between ferroelectricity and superconductivity was further reinforced from symmetry argument, the so-called “Matthias conjecture”.¹

Fifty years ago though, Anderson and Blount predicted the possibility of a ferroelectric-like transition in metals.² Motivated by the recent experimental verification that such a material exists³ and the observation of ferroelectricity in underdoped $\text{La}_2\text{CuO}_{4+x}$,⁴ we undertook to review the question of ferroelectricity and superconductivity.

After briefly recalling some examples of ferroelectrics, which, once doped or reduced, become superconductors, we shall give an overview of the recent experimental observations of ferroelectric (or ferroelectric-like) behavior in high- T_C superconductors, including magnetoelectricity.⁵

Then, the various approaches used to tackle the two phenomena within a common framework shall be presented, motivated by the possible increase in T_C that may result from the enhancement of the electron-phonon coupling due to the soft-mode behavior of displacive ferroelectrics.

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