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Dielectric oxides: How to enhance their beneficial properties[1]

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Dielectric materials are essential for a large number of applications. It is extensively used for electrical energy storage in capacitors and also plays a crucial role in miniaturization of MOSFET's. However, further shrinking of the physical size of such devices with same device capabilities will require the discovery of materials with higher dielectric constants and lower losses than available at present. In fact, in most cases, a combination of several dielectric properties is considered to be optimal, for example, minimal temperature and frequency dependencies of dielectric properties being important in many cases in addition to a large value of the dielectric constant and a low loss. In this talk, I shall discuss two separate series of oxides with useful dielectric properties. In the first example, I shall show that a disorder in the B-site of a family of disordered hexagonal transition metal oxides leads to robust and unusually enhanced dielectric properties, suggesting this to be a general route to prepare oxide materials with such advance properties. In the second example, we start with $SrTiO_3$ which is a well-known dielectric material. We shall then discuss various possibilities to enhance dielectric properties of $SrTiO_3$ by suitable doping. This work is based on collaborative studies involving the following people: Debraj Choudhury, S. V. Bhat, K. T. Delaney, J. Gopalakrishnan, C. Kakarla, Olof Karis, P. Lazor, R. Mathieu, P. Mondal, , P. Nordblad, A. Negi, R.Nirmala, B. Sanyal, N. A. Spaldin, P. Sujatha Devi, A. Sundaresan, A. Venimadhav, U. V. Waghmare and D. D. Sarma

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