

Winter 3-7-2016

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Recommended Citation

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ELECTRIC FIELD-INDUCED ELECTRONIC CONDUCTION IN BULK OXIDE CERAMICS

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Field-induced electronic conduction is widely recognised in (a) materials whose resistance is dominated by interfacial Schottky barriers and (b) thin films that exhibit high field-induced filamentary conduction. A third category of (low) field-sensitive conduction occurs in bulk oxide ceramics that show enhanced hole conduction if they are acceptor-doped, but reduced n-type conduction if they are donor-doped. Examples in these two categories are acceptor-doped titanate perovskites [1] and rutile that is slightly oxygen-deficient [2]. More recently, reversible, field-induced electronic conduction has been demonstrated in yttria-doped zirconia ceramics [3] and a reversible, insulator-metal transition in Ca-doped BiFeO₃ ceramics [4].

A survey of these phenomena and their characteristics will be presented and possible mechanisms, involving redox activity of oxygen in the oxide ceramic structures, discussed. Possible implications in a range of fields, including dielectric breakdown, lithium battery cathodes, memristive switching and insulator-metal transitions will be highlighted for discussion.

- [1] H Beltran et al, J Amer Ceram Soc., 94 (2011) 2951
- [2] Y Liu and AR West, Appl Phys Lett., 103 (2013) 263508
- [3] N Maso and AR West, Chem Mater., 27 (2015) 1552
- [4] N Maso et al, Phys Chem Chem Phys., 16 (2014) 19408