Ferroelectrics: Historical Introduction

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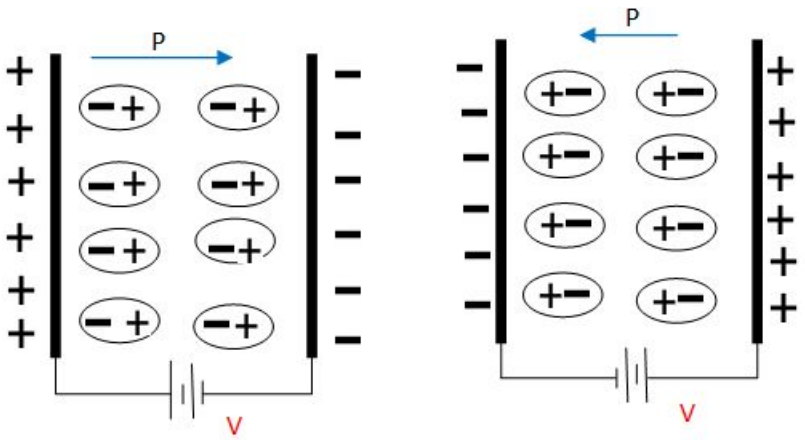
Ferroelectricity

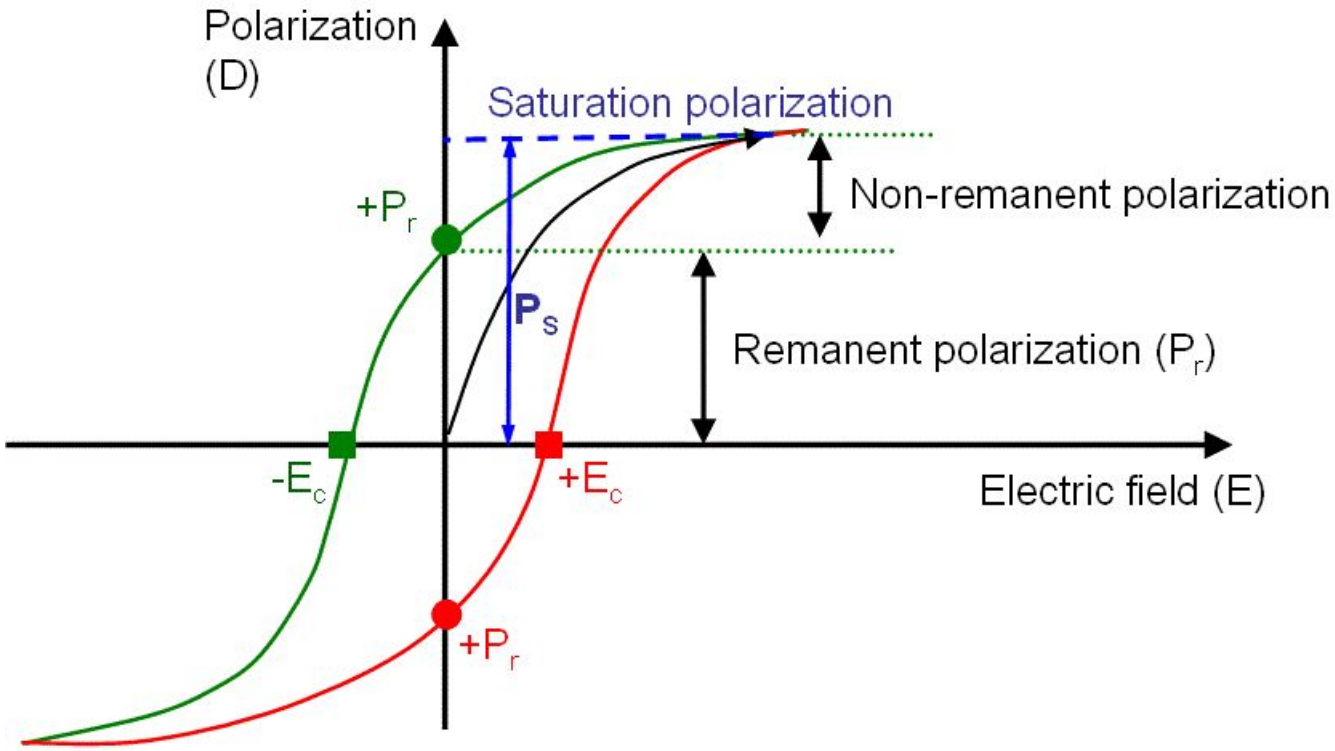
= reversible spontaneous polarization



Asymmetric crystal structure is required!

Ferroelectricity

= reversible spontaneous polarization



Ferroelectric materials

- Typical ferroelectrics are complicated ceramic compounds of transition metals (titanates, niobates, tantalates, etc.)
- NO IRON!
- All FE materials are also pyroelectrics and piezoelectrics

Early years (1920-1930)

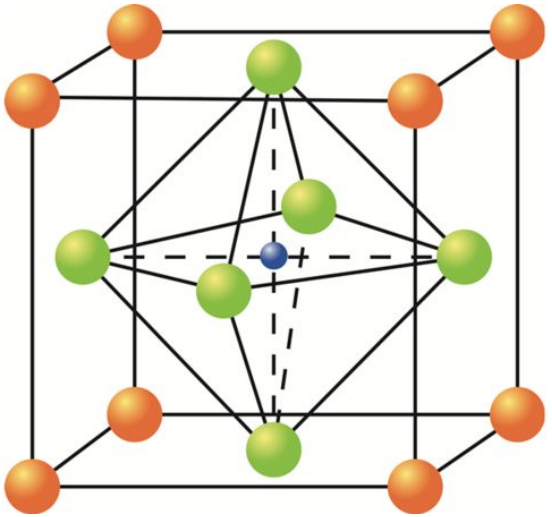
- FE effect first discovered in Rochelle salt by Valasek (1920)
- Materials: Single crystalls (Rochelle salt, ADP, KDP)
- Methods: Solution growth
- Applications: Photo pickup

Discrete elements (1940-1960)

- Materials: ceramics (BT, PZT, LT, SBN, etc.)
- Methods: casting, pressing, evaporation, sputtering
- Applications: Hi-k Caps, acoustic tranducers, filters, heat detectors
- 1952: PZT was synthesized in Tokyo Institute of Technology

Hybrid microelectonics (1970-1990)

- Perovskite structure materials (Perovskii, 1895)



- Materials: thin films (PZT, PZLT, PLT, LN, SBN)
- Methods: sol-gel, LPE, MBE, CVD, MOCVD, PECVD
- Applications: MEMS, NVM, IR sensors

Integrated circuits (since 2000)

- Materials: ultra thin films (HfO_2, ZrO_2)
- Methods: CVD, MOCVD, ALD
- Applications: NVM, NN, IR starring arrays
- Main problems: phase transitions, FE induced/suppressed by stress and strain and influenced by surface states and defects.