

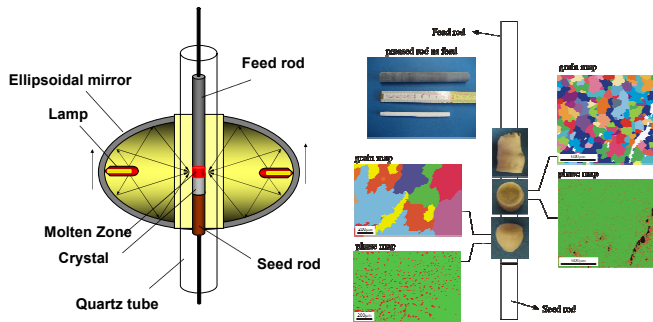


Nonlinear electrical properties of grain boundaries in BaZrO_3

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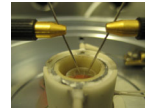
Max Planck Institute for Solid State Research, Stuttgart, Germany

• Large grained sample: Infrared Image Furnace (~2600 °C)

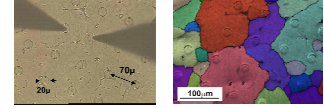


• Microcontact impedance spectra of individual GBs:

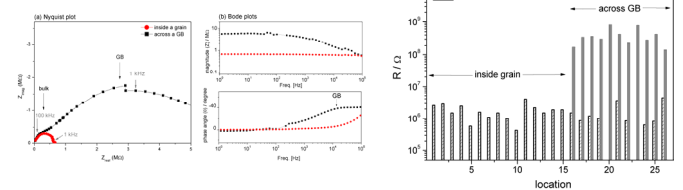
Microcontact setup



Microelectrodes and position of needles

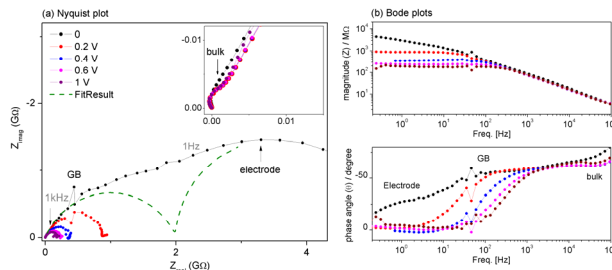


Impedance spectra within one grain / across one GB

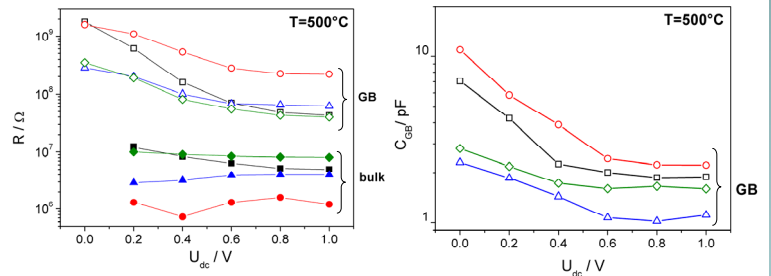


• GB electrical properties under DC bias:

Impedance spectra under DC bias:

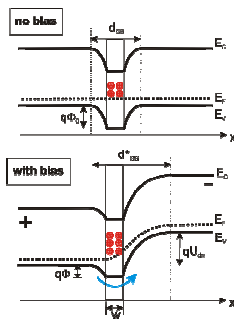


Voltage dependent GB resistance and capacitance:



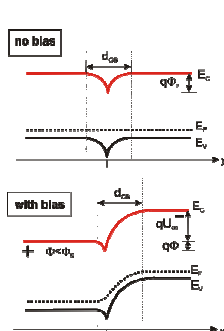
• Voltage dependent GB electrical properties explained by different models:

Schottky barrier with interface states



- ☐ Thermionic emission
- ☐ Drift-diffusion
- ☐ Electron tunnelling

Schottky barrier without interface states



Continuous GB secondary phase as reason for blocking GB:
- could also lead to R_{GB} decreasing with bias
(BV-analogous increase of electron/proton hopping rate)
- but constant C_{GB} expected

Reiss, Maier, Phys. Rev. Lett.
100 (2008) 205901

capacitance of space charge zones:

* model with interface states:

- core charge increases under bias
- depletion zone broadens
- C_{GB} decreases already at moderate bias

Entang,
J. Appl. Phys.
48 (1977) 4372

* model without interface states:

- large bias: incomplete depletion on one side
- depletion zone broadens → C_{GB} ↓

Holling, Waser,
J. Appl. Phys.
91 (2002) 3037

- * $R_{bulk} \approx \text{constant}$ (C_{bulk} hidden by C_{stray})
- * R_{GB} decreases with applied bias
- * C_{GB} decreases with applied bias

decrease of R_{GB} and C_{GB} under
DC bias supports space charge model