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Flash sintering of SrTiO3

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Flash-sintering of $SrTiO_3$

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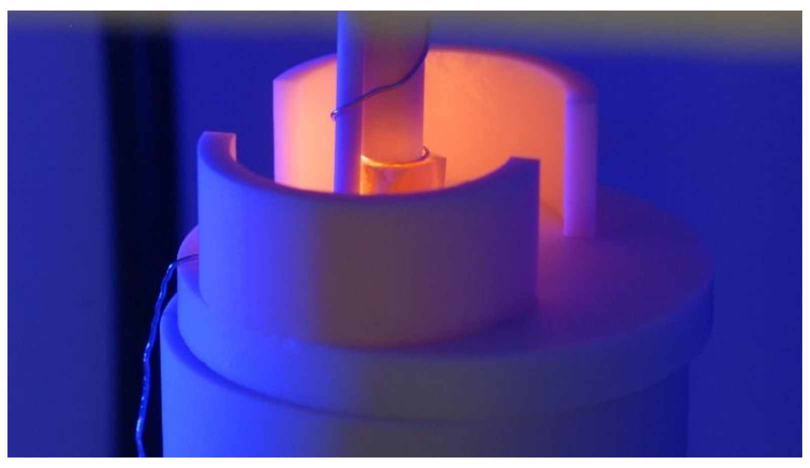
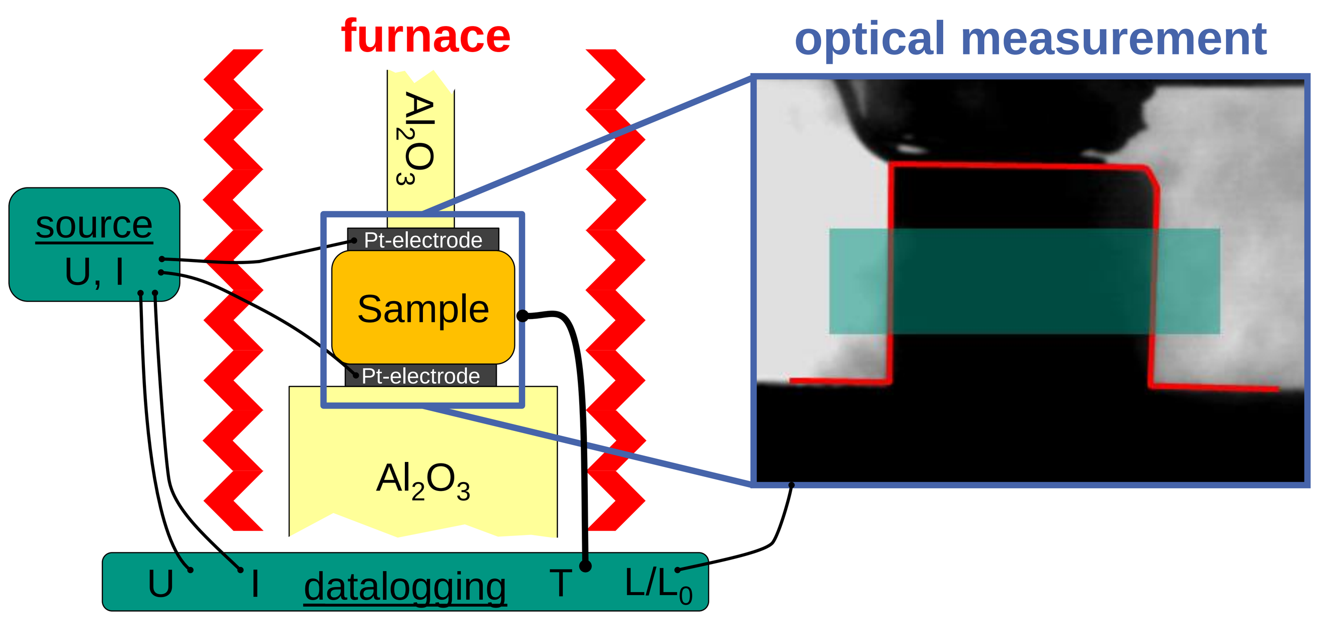
Introduction and motivation

Sintering and grain growth experiments under an electrical field are conducted with $SrTiO_3$. Defect chemical calculations are implied to discriminate the most important parameters in the flash sintering process. A strong correlation of the onset of flash sintering with the defect chemistry was found. By controlling the current of the power source, the joule heating of the sample can be controlled. The results show many analogies to conventional sintering.

Experimental setup



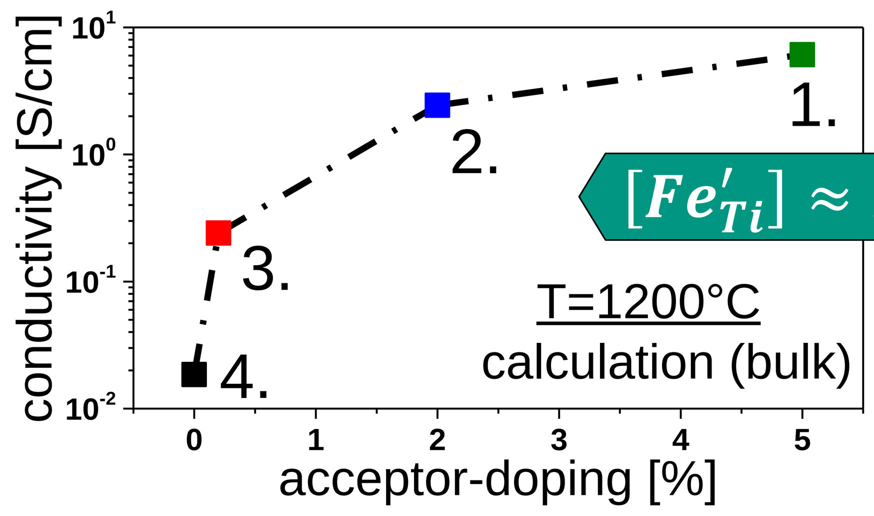
flashed sample in opened furnace at ~500 °C

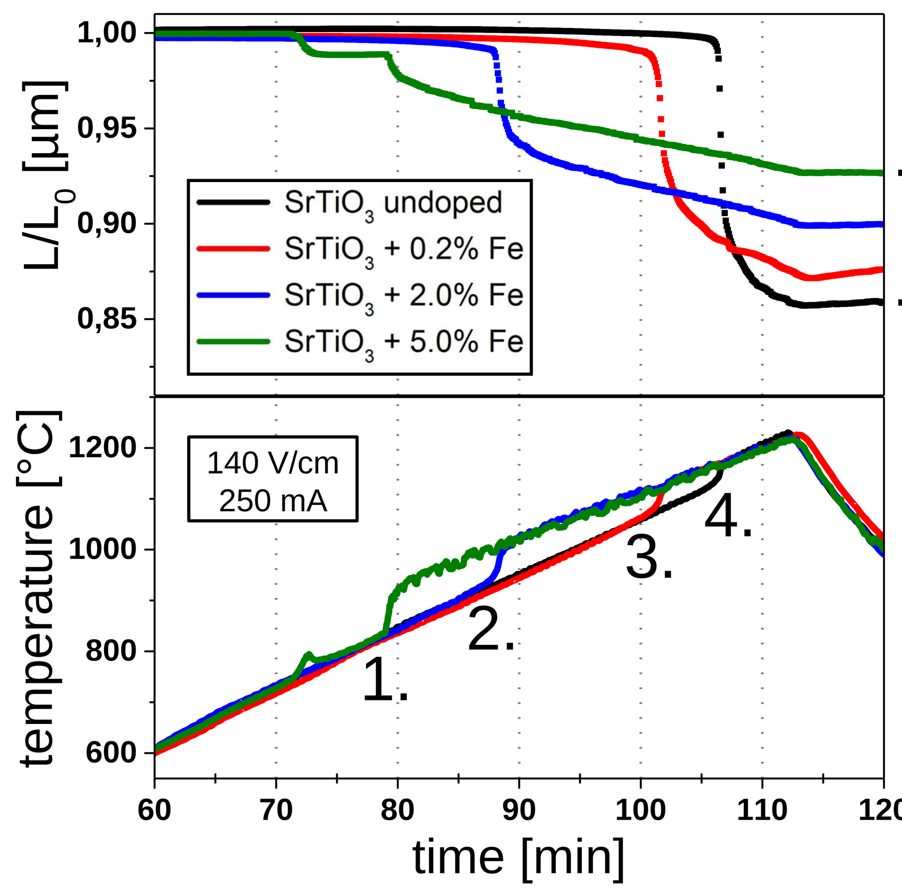


- material: $SrTiO_3$
- influence of power control
- impact of Fe doping
- microstructural analysis
- analogy to conventional sintering

Flash-sintering (CHR)

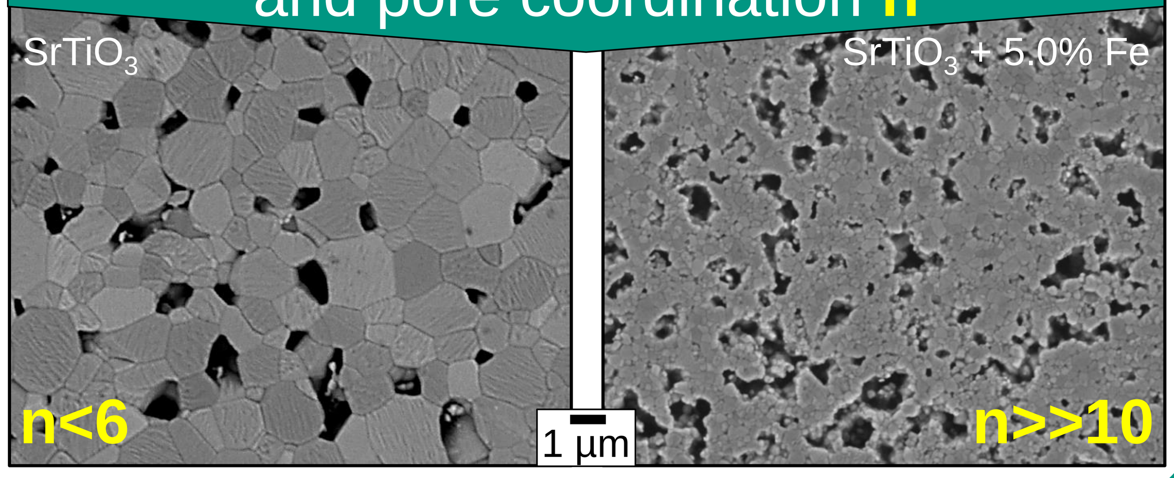
- Onset of flash-sintering shifts to lower temperatures with increased doping.
- A correlation with the conductivity is found by defect chemical calculations.



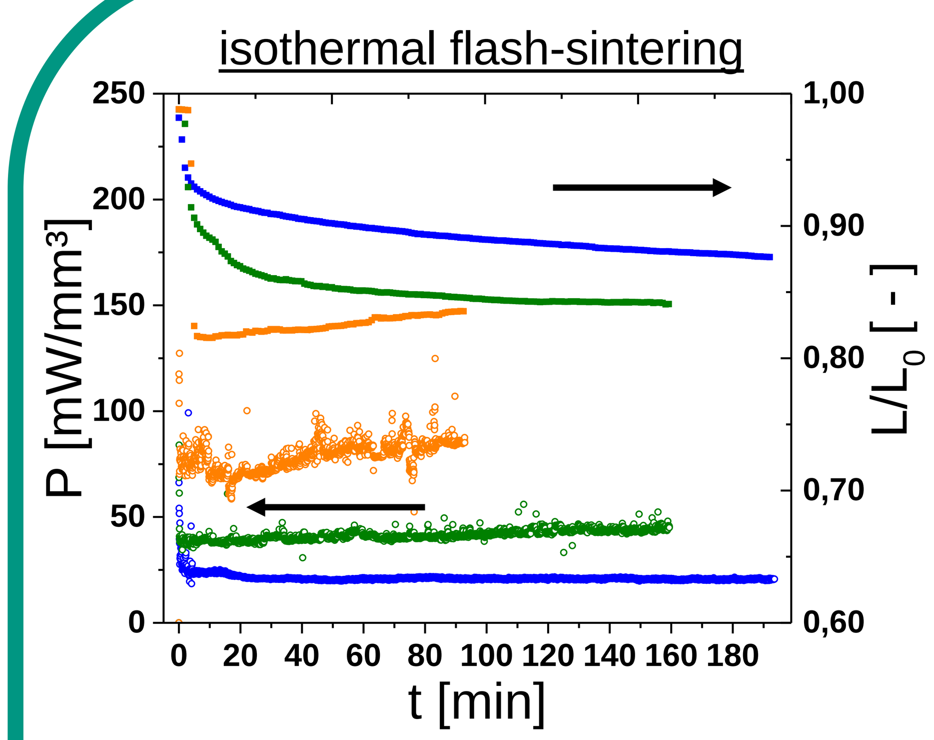


Similar to conventional sintering, doping results in decreasing densitiy.

Possible correlation with microstructure and pore coordination **n**



Control of sample temperature



	$T_{furnace}$	$T_{meas.}$	$T_{calc.}$
100mA	1150°C	1180°C	1190°C
200mA	1150°C	1190°C	1275°C
500mA	1150°C	1200°C	1345°C
120mA	1120°C	1170°C	1240°C

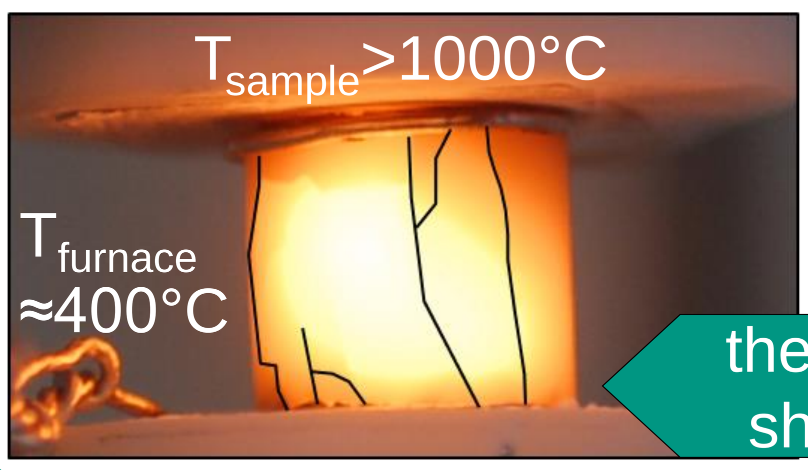
$$\frac{T_{calc.}}{T_{meas.}} = \left[1 + \frac{1000 \cdot W_V}{\sigma \cdot T_{meas.}^4} \cdot \left(\frac{V}{A}\right)\right]^{1/4}$$

Black body radiation model

Joule heating during flash-sintering

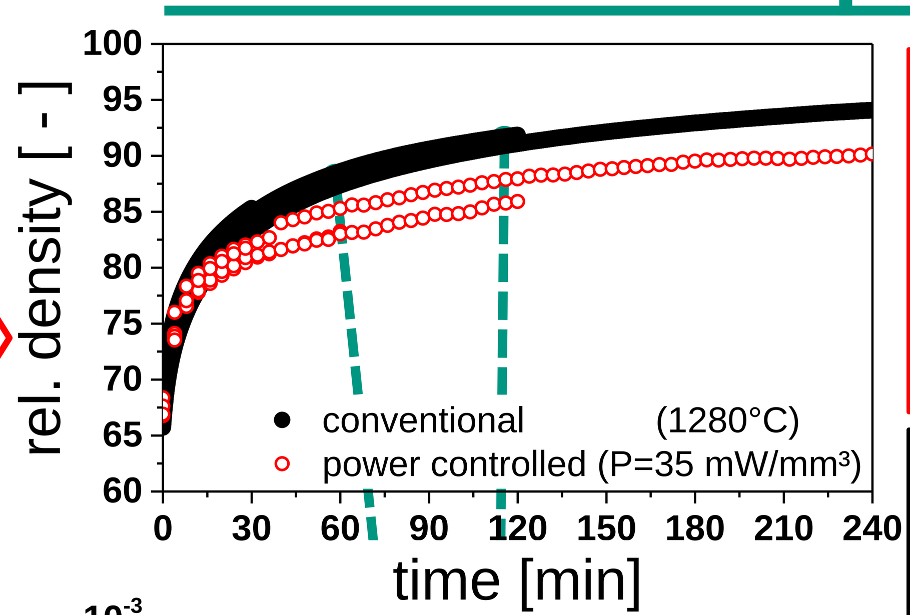
Raj, *J. Eur. Ceram. Soc. 32*, p.2293 (2012)

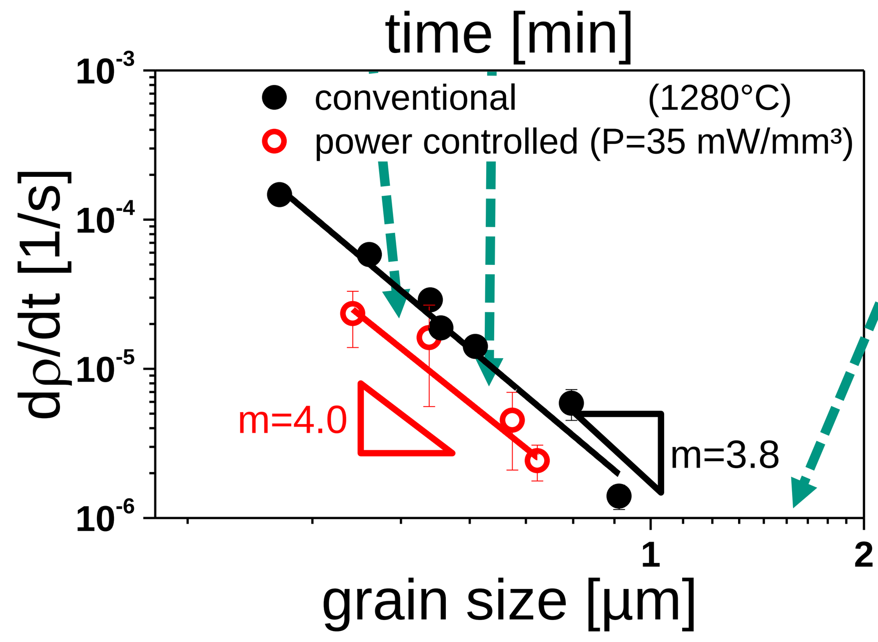
- Temperature increases with current flow.

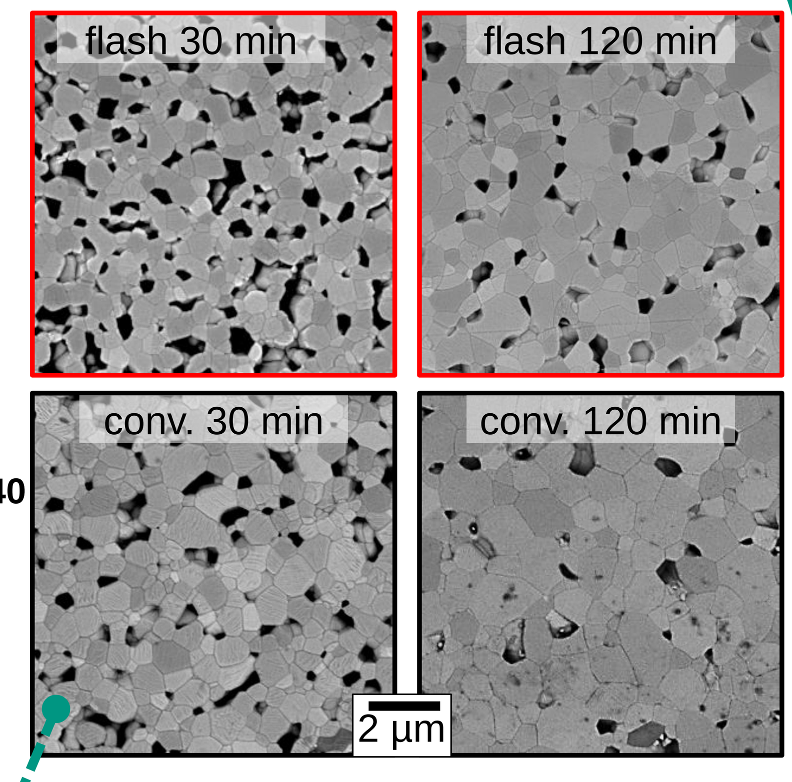


thermal shock

Process gets more unstable for high ΔT.







- Densification via grain boundary diffusion (m~4).
- Microstructure is similar to conventional sintering.

Conclusion and perspective

- Temperature control of the sample is possible (power-control).
- Combination with defect chemical calculations enhances understanding.
- Similarities to conventional sintering are found (densification and microstructure).

Statement: It‘s Joule heating