

Winter 3-11-2016

# Flash sintering of SrTiO<sub>3</sub>

Fabian Lemke

*Karlsruhe Institute of Technology, fabian.lemke@kit.edu*

Follow this and additional works at: [http://dc.engconfintl.org/efa\\_sintering](http://dc.engconfintl.org/efa_sintering)



Part of the [Engineering Commons](#)

---

## Recommended Citation

Fabian Lemke, "Flash sintering of SrTiO<sub>3</sub>" in "Electric Field Assisted Sintering and Related Phenomena Far From Equilibrium", Rishi Raj (University of Colorado at Boulder, USA) Thomas Tsakalakos (Rutgers University, USA) Eds, ECI Symposium Series, (2016). [http://dc.engconfintl.org/efa\\_sintering/63](http://dc.engconfintl.org/efa_sintering/63)

This Abstract and Presentation is brought to you for free and open access by the Proceedings at ECI Digital Archives. It has been accepted for inclusion in Electric Field Assisted Sintering and Related Phenomena Far From Equilibrium by an authorized administrator of ECI Digital Archives. For more information, please contact [franco@bepress.com](mailto:franco@bepress.com).

# Flash-sintering of SrTiO<sub>3</sub>

Institute for Applied Materials - Ceramic Materials and Technologies (IAM-KWT)

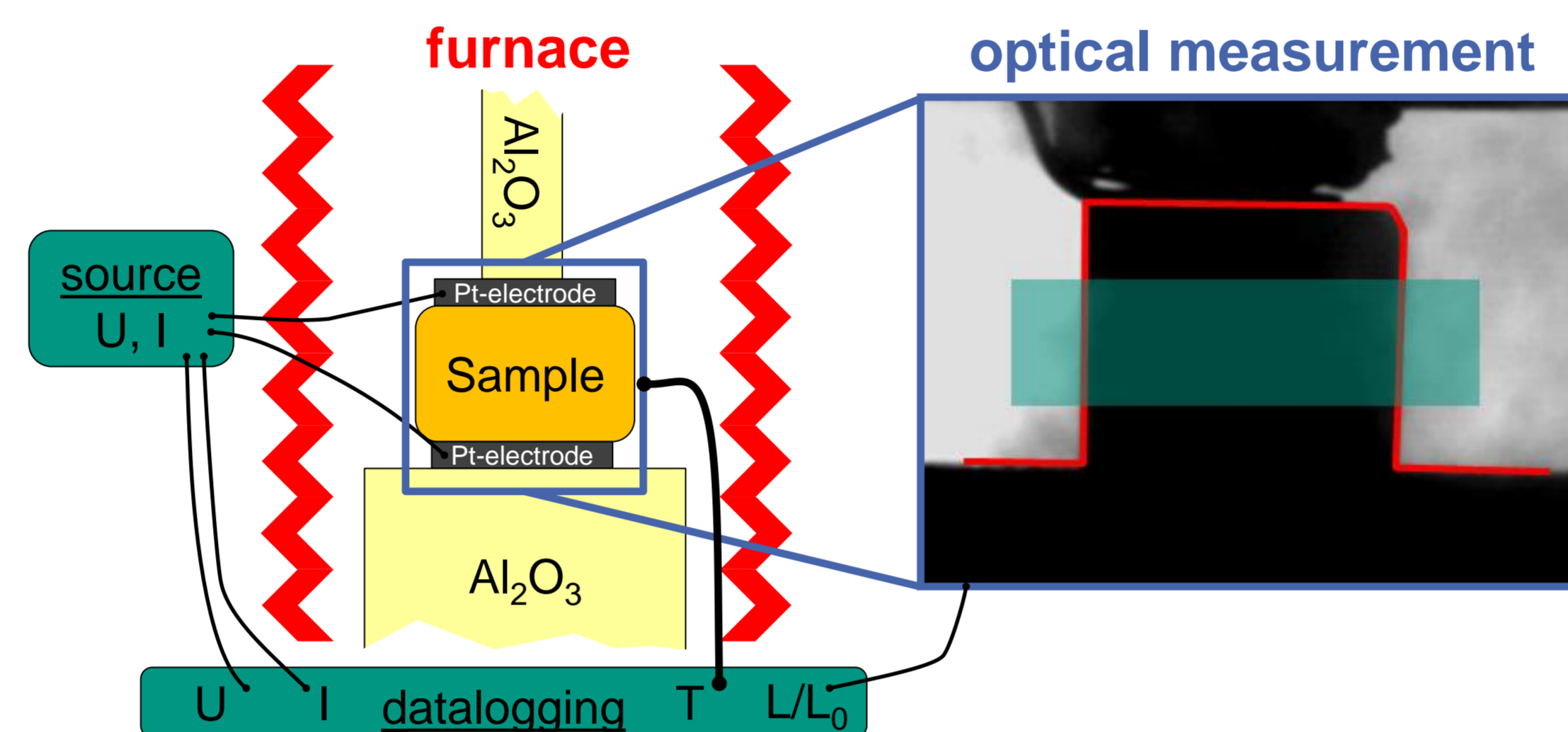
F. Lemke, W. Rheinheimer, M.J. Hoffmann

## Introduction and motivation

Sintering and grain growth experiments under an electrical field are conducted with SrTiO<sub>3</sub>. 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.



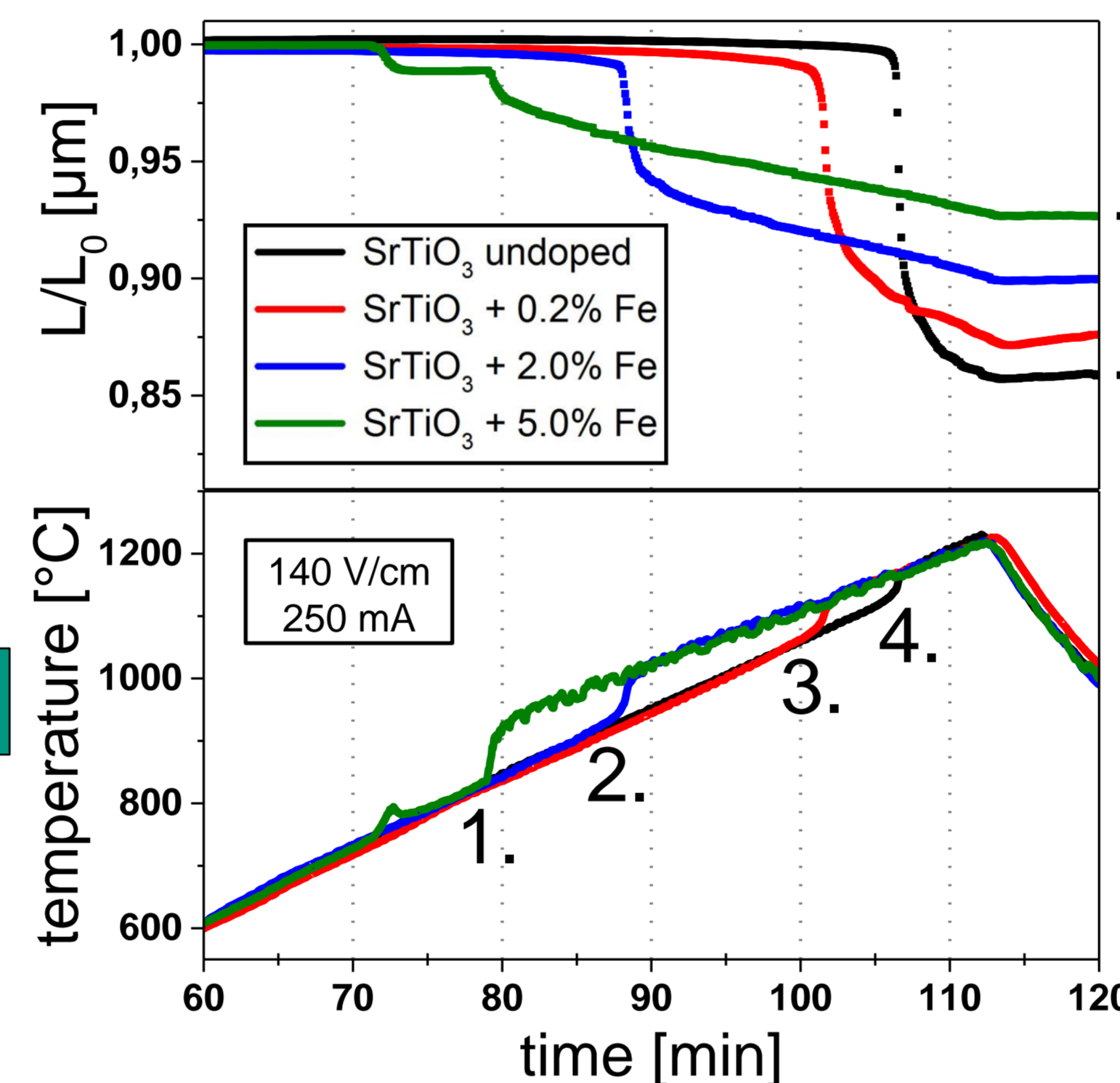
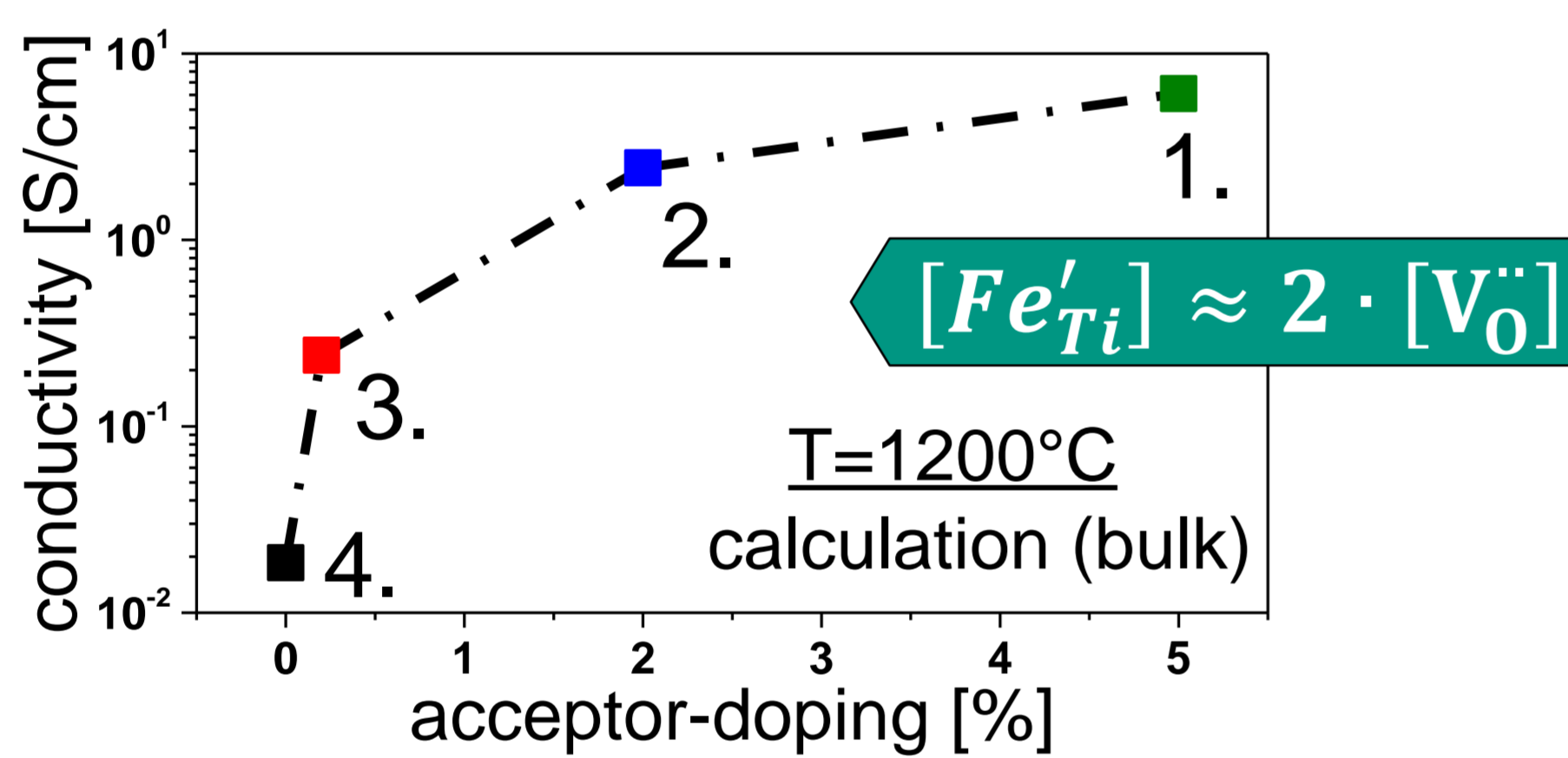
flashed sample in opened furnace at ~500 °C



## Experimental setup

- material: SrTiO<sub>3</sub>
- influence of power control
- impact of Fe doping
- microstructural analysis
- analogy to conventional sintering

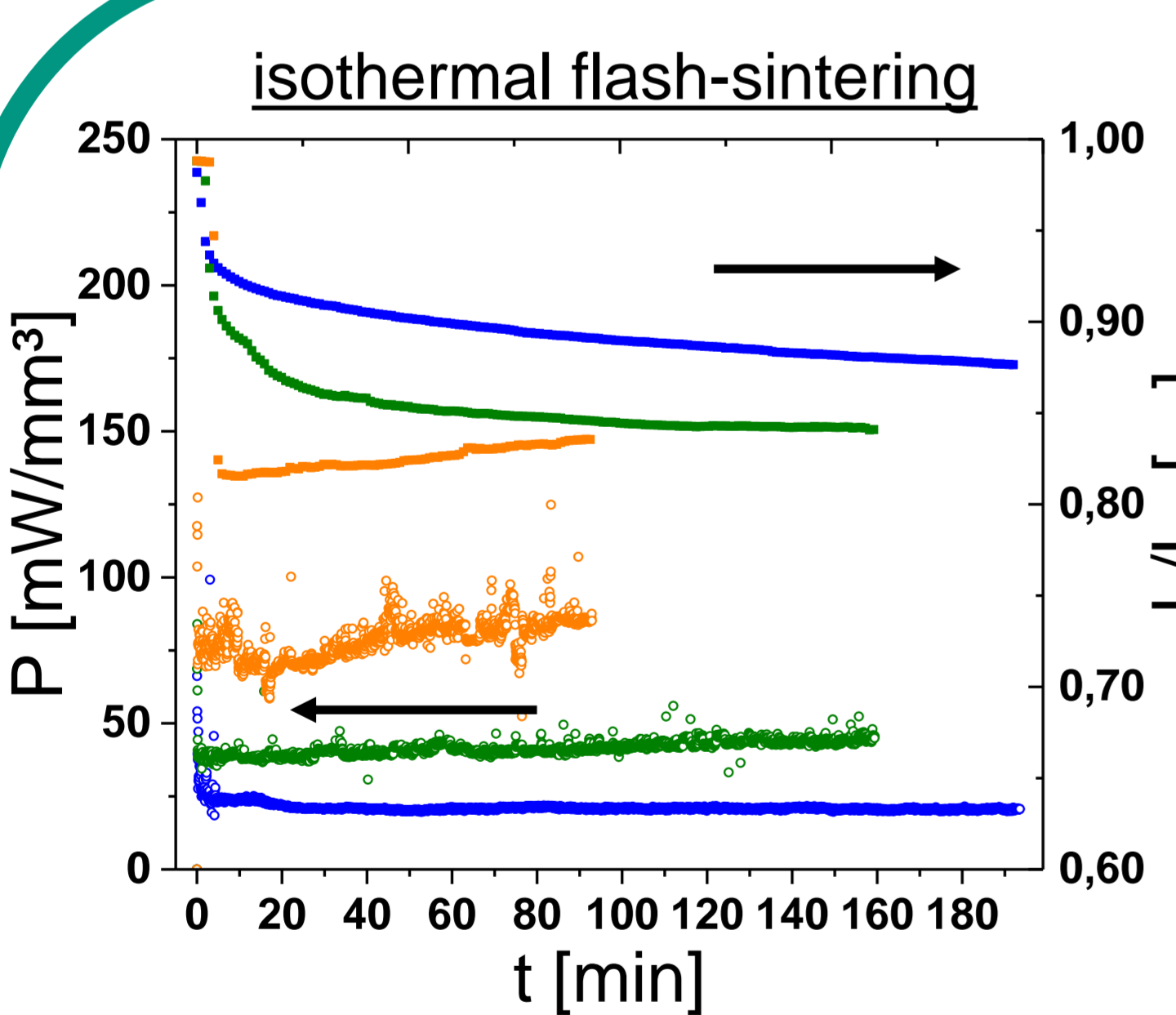
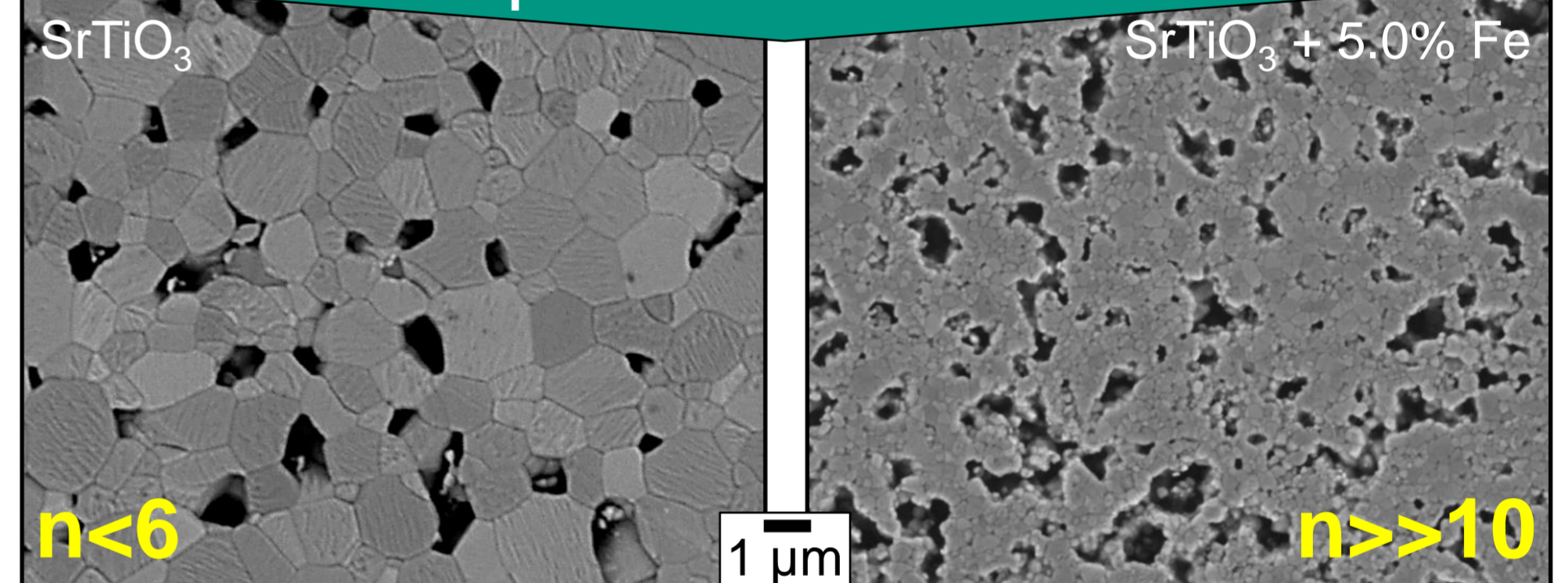
- Onset of flash-sintering shifts to lower temperatures with increased doping.
- A correlation with the conductivity is found by defect chemical calculations.



## Flash-sintering (CHR)

Similar to conventional sintering, doping results in decreasing density.

Possible correlation with microstructure and pore coordination  $n$

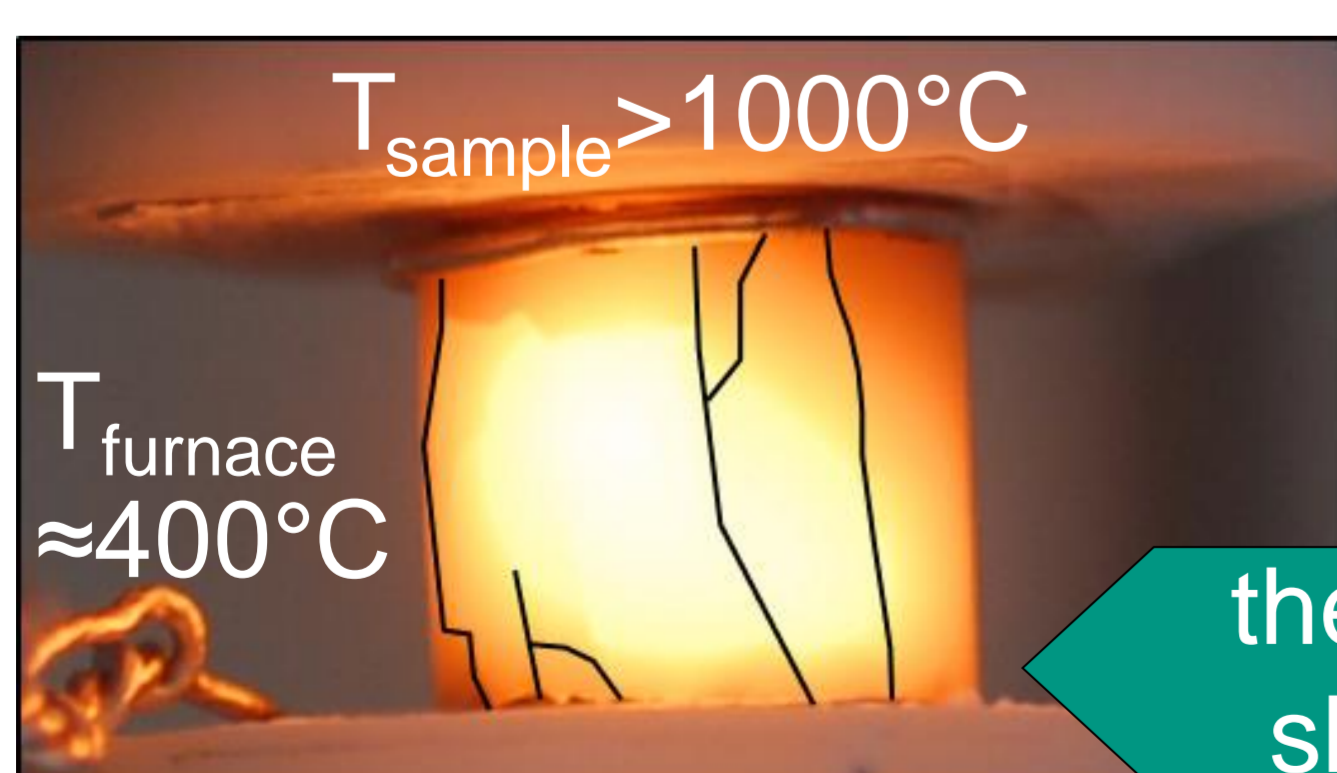


	T <sub>furnace</sub>	T <sub>meas.</sub>	T <sub>calc.</sub>
100mA	1150°C	1180°C	1190°C
200mA	1150°C	1190°C	1275°C
500mA	1150°C	1200°C	1345°C
120mA	1120°C	1170°C	1240°C

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

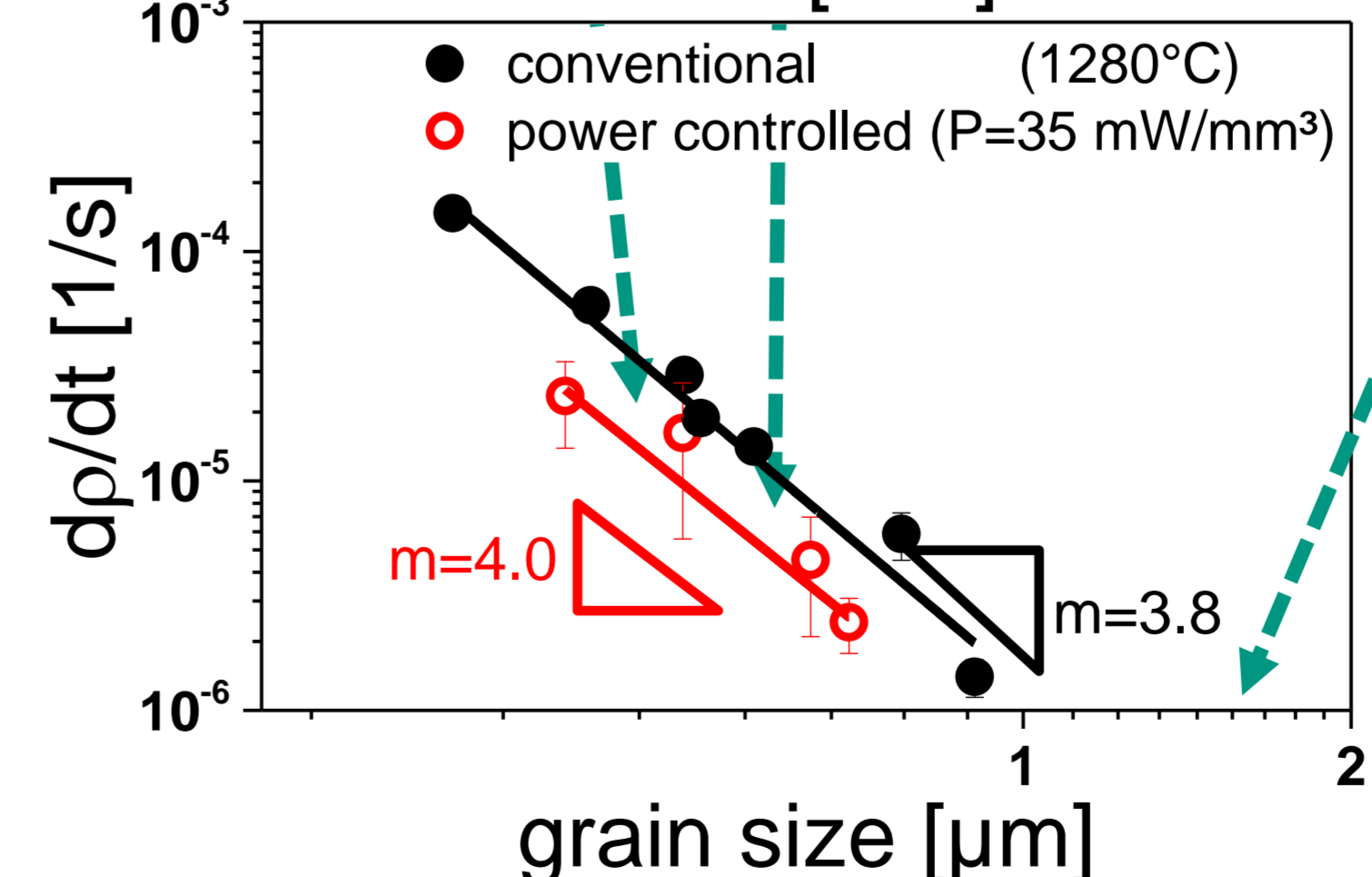
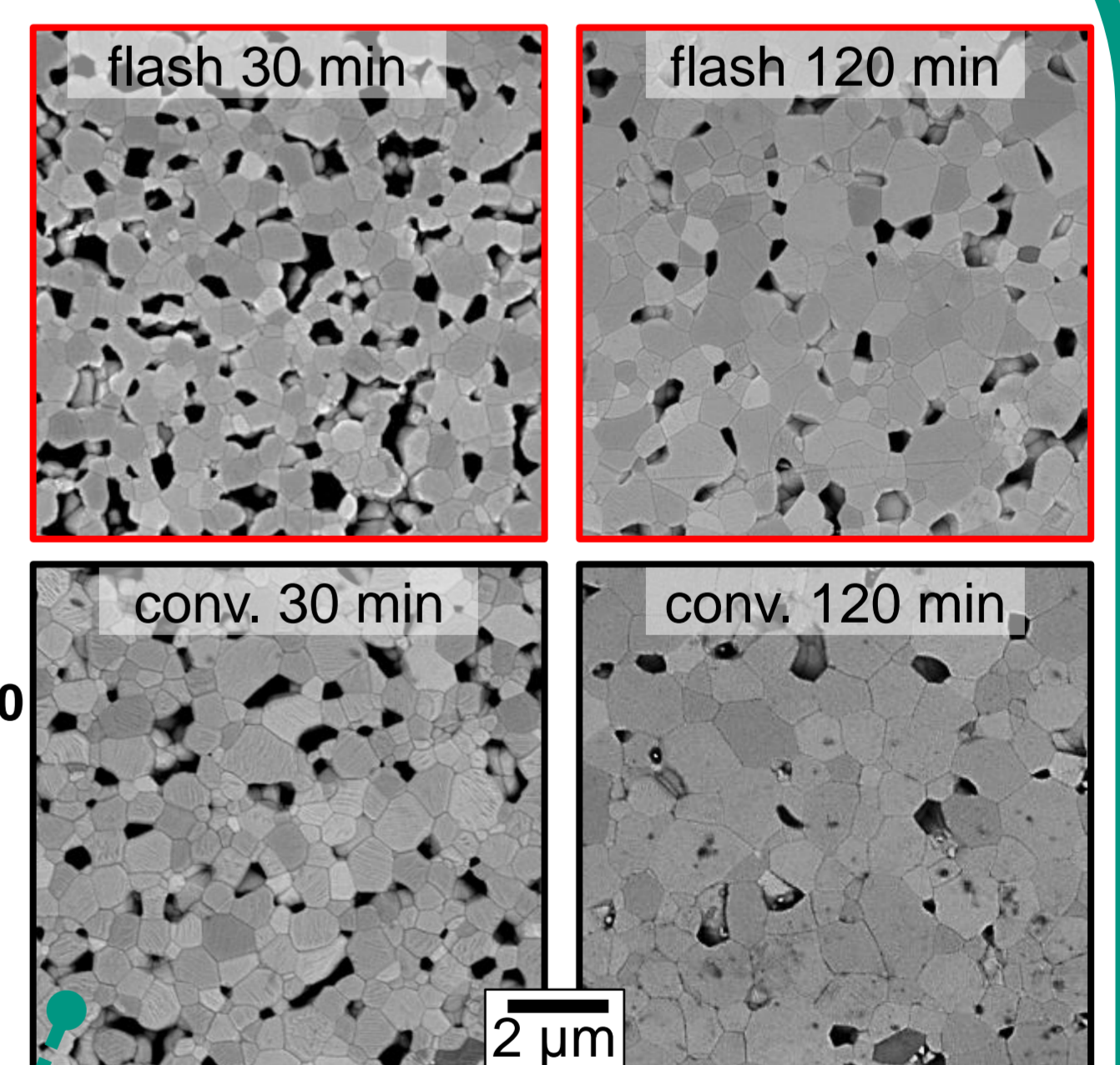
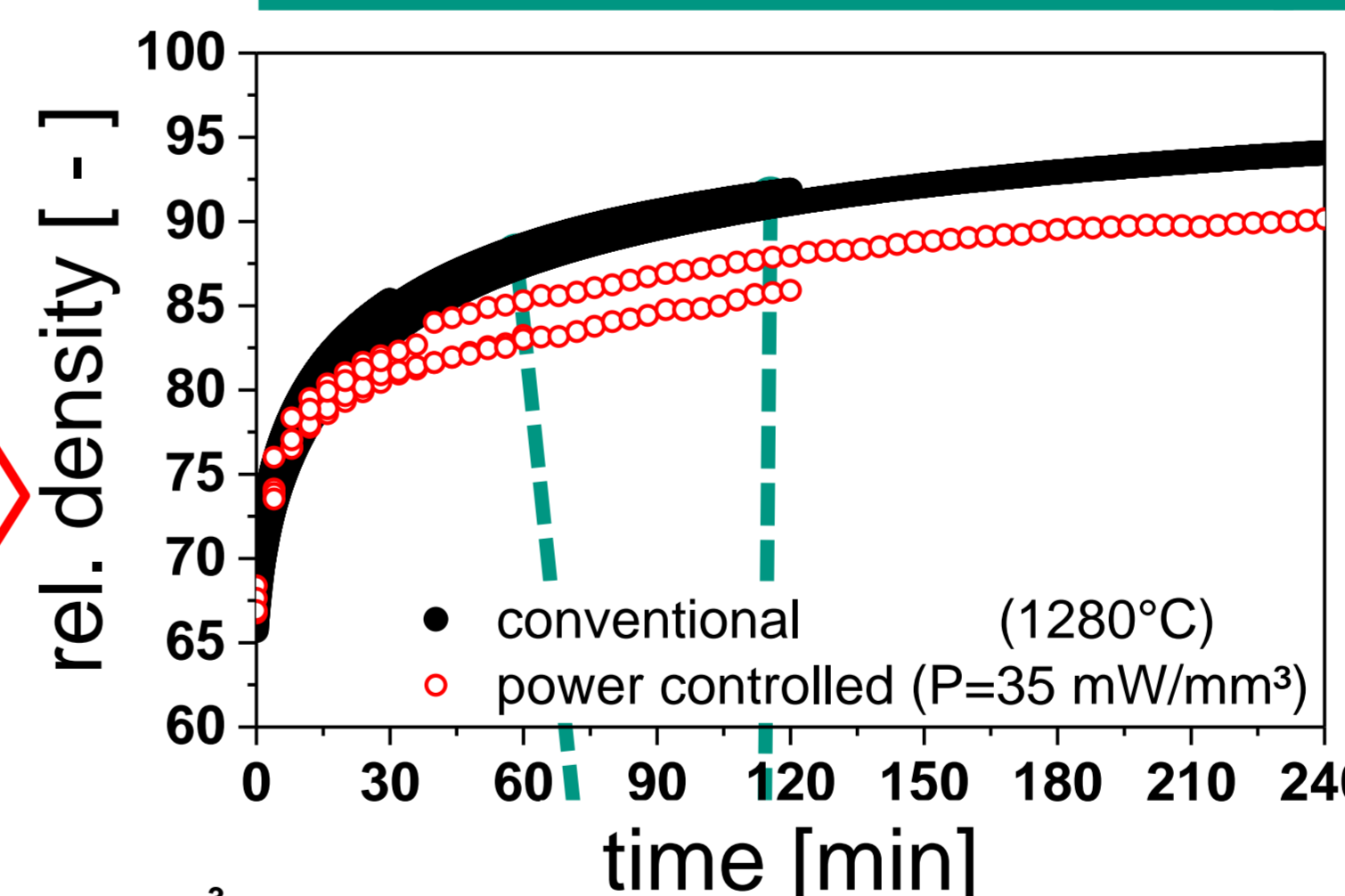
Black body radiation model  
Joule heating during flash-sintering  
Raj, J. Eur. Ceram. Soc. 32, p.2293 (2012)

- Temperature increases with current flow.



Process gets more unstable for high ΔT.

## Control of sample temperature



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

- Temperature control of the sample is possible (power-control).
- Combination with defect chemical calculations enhances understanding.

## Conclusion and perspective

- Similarities to conventional sintering are found (densification and microstructure).

**Statement:**  
It's Joule heating