TECHNISCHE UNIVERSITÄT WIEN
Vienna | Austria

Characterization and investigation of Fe:STO thin films prepared by pulsed laser deposition

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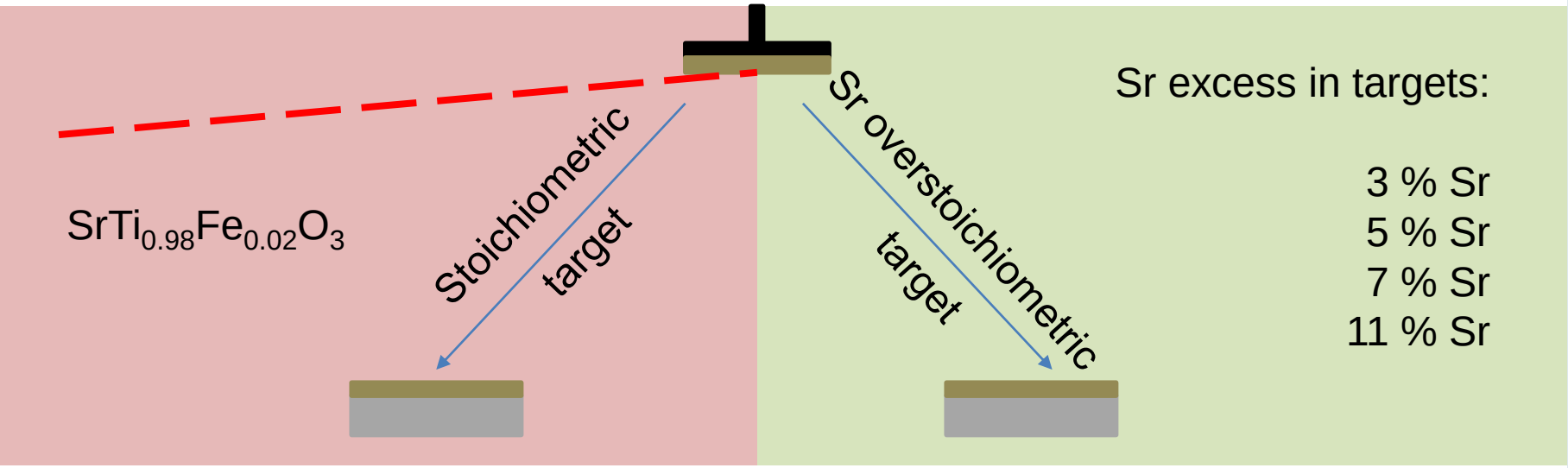
Introduction

- Bulk $SrTiO_3$ well researched, defect model well known
- Conductivity of STO can be tailored by doping
- Effect of cation nonstoichiometry on (electrical) properties not so well researched
- Aim: linking stoichiometry, structure and properties of Fe:$SrTiO_3$

Sample preparation via PLD



Deposition parameters
Standard: 400 mJ set, 650 °C, 0.15 mbar O_2; 5 Hz

Variation of laser fluence and repetition rate for stoichiometric targets

Substrates:
Electrical measurements: Nb:STO

XRD (reciprocal space map): STO

XRD (thin film gracing incidence): MgO

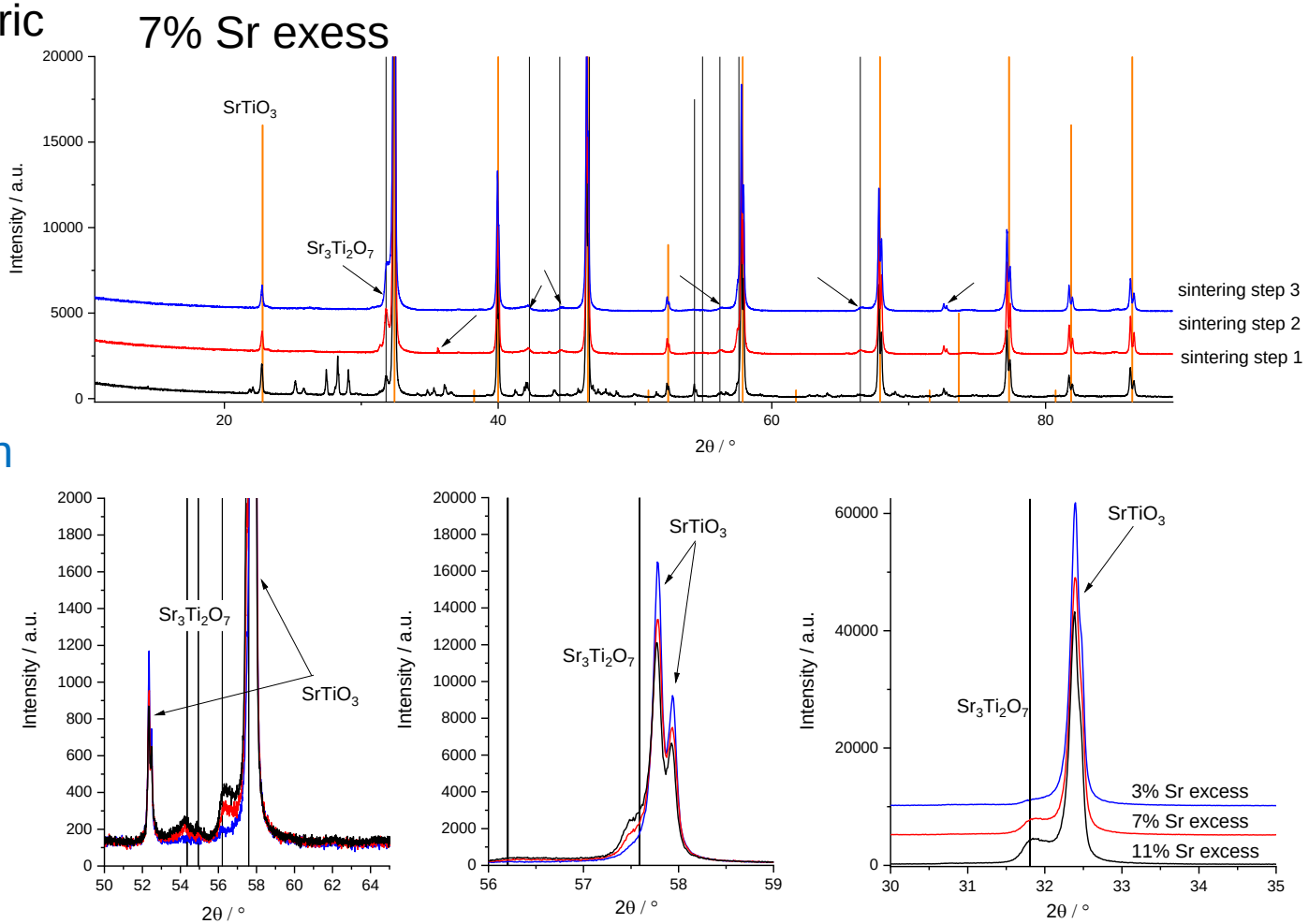
ICP-OES: MgO

X-ray diffraction of targets

With Sr overstoichiometry

Overstoichiometric targets:
Solid state route
pressing, then
1) 1000 °C, 2 h
2) 1200 °C, 4 h
remilling and
pressing
3) 1400 °C, 4.5 h

Sr-rich phases are present even after three sintering steps.



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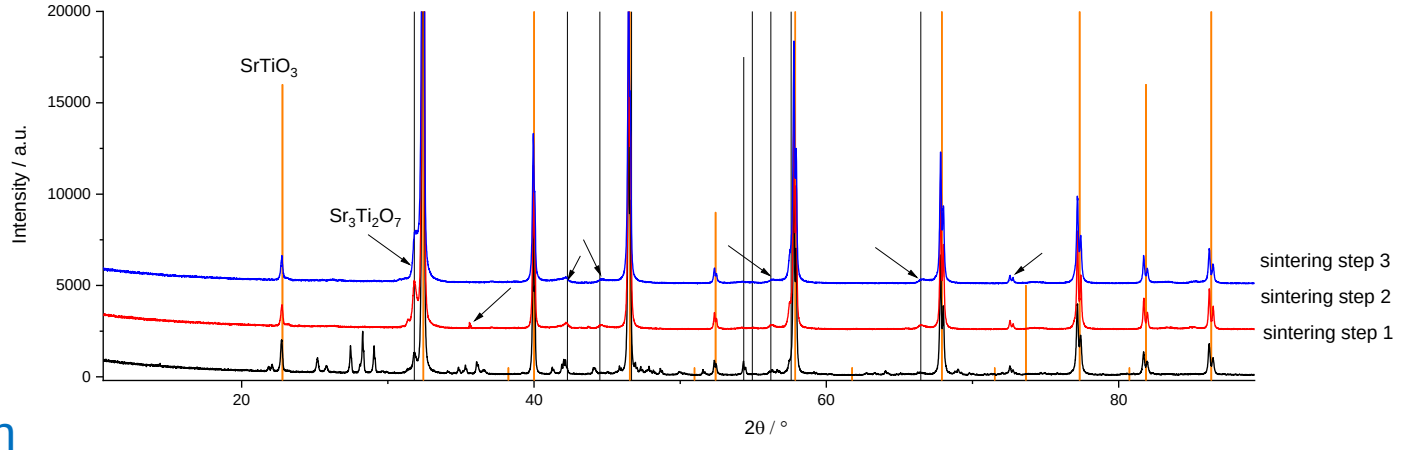
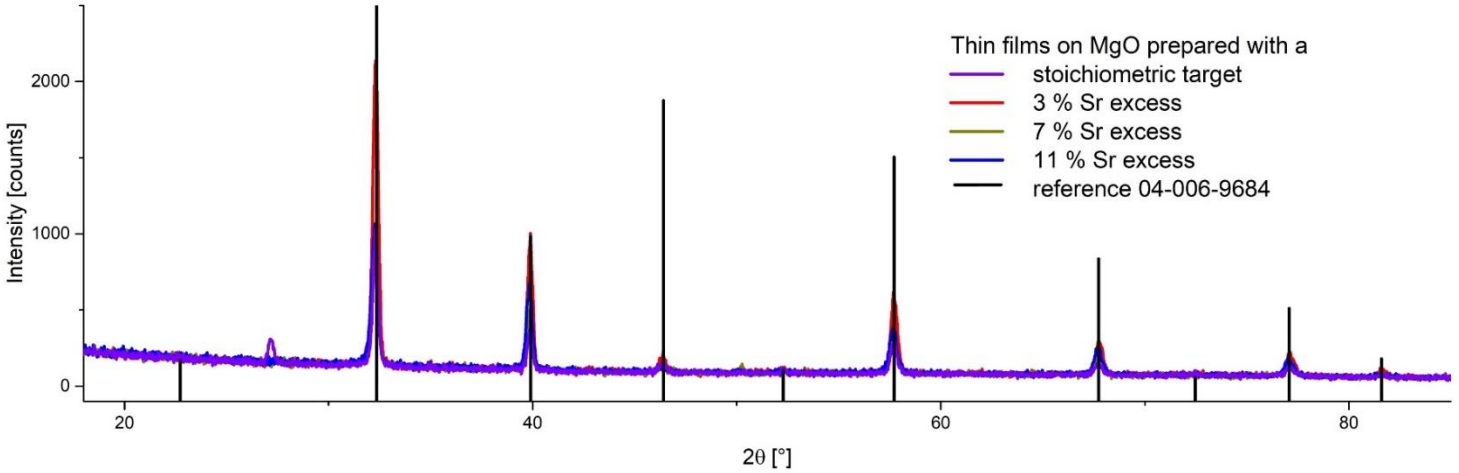
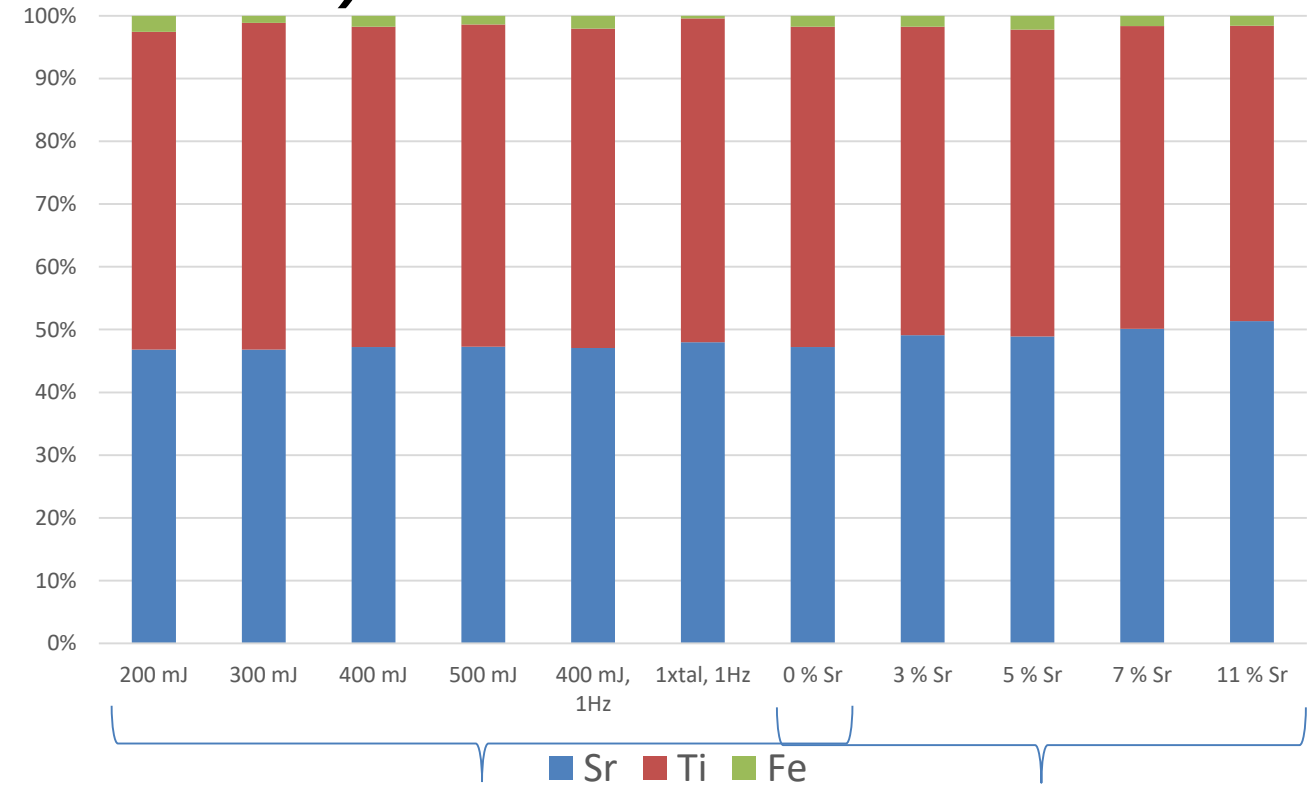


Thin films are phase pure



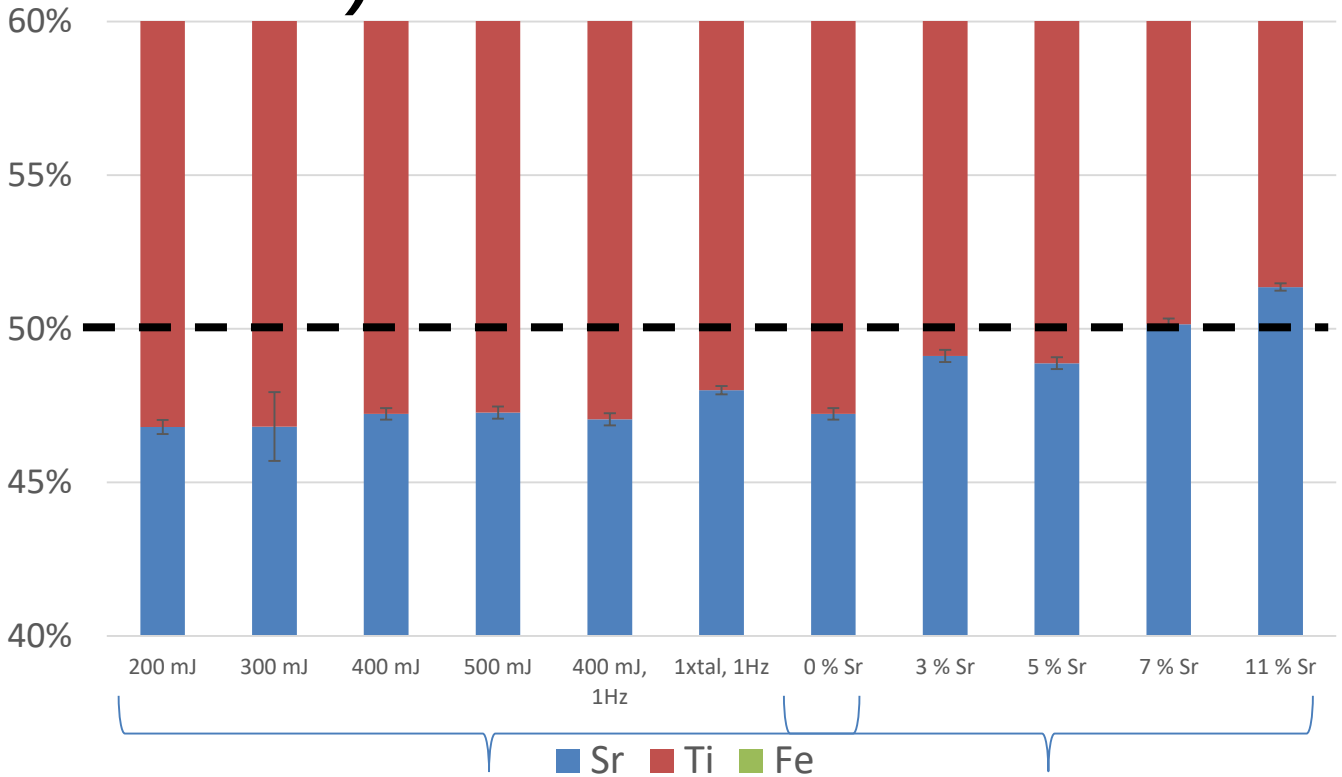
Chemical analysis of thin films (ICP-OES)



Deposited from a stoichiometric target

Sr excess in the target

Chemical analysis of thin films (ICP-OES)



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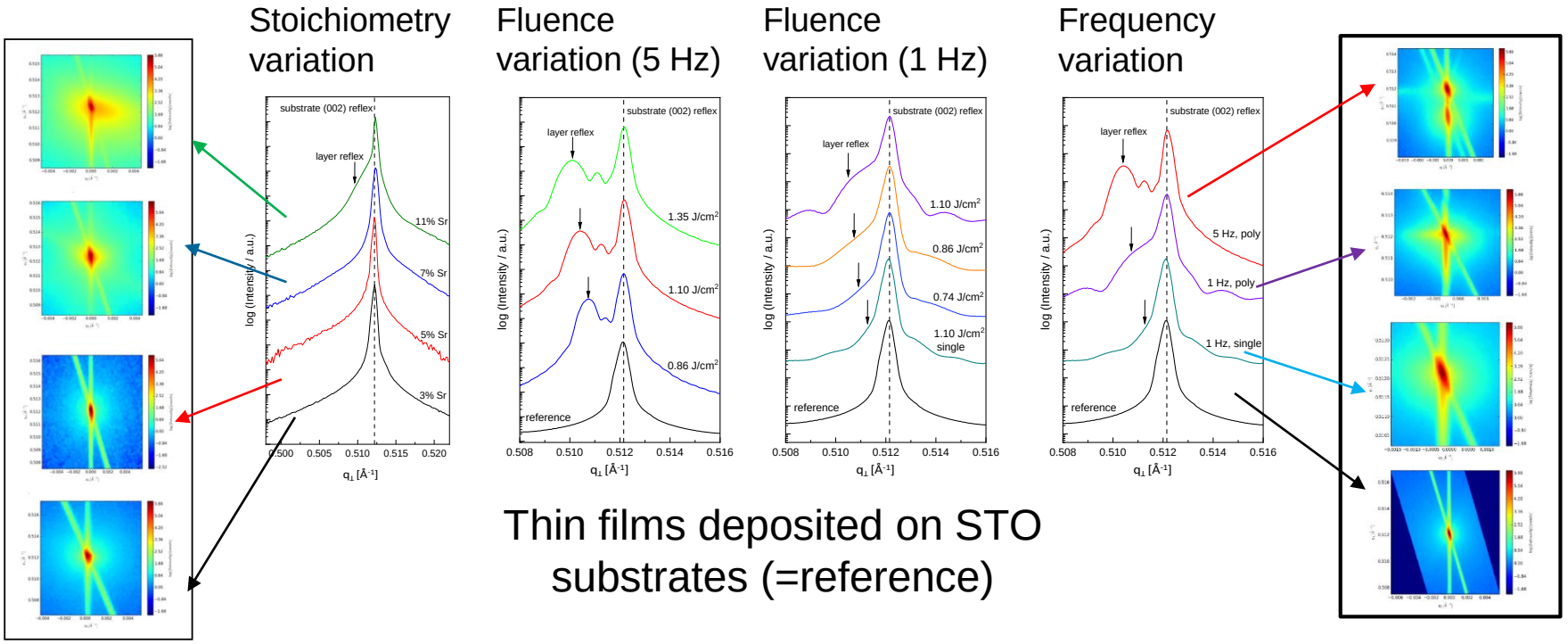


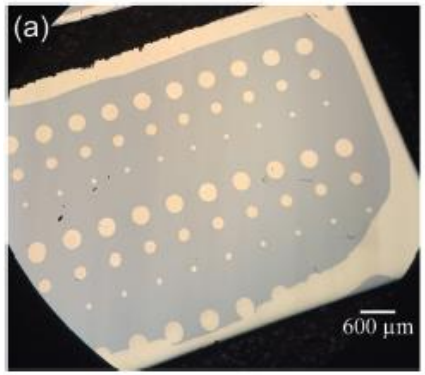
Thin films deposited on STO substrates (=reference)

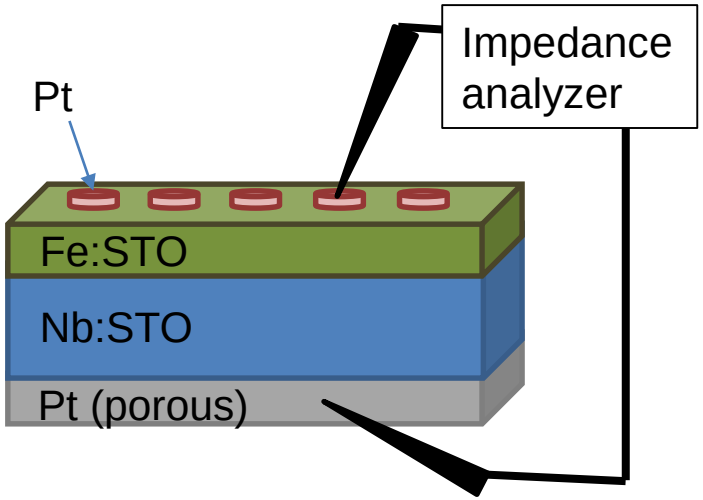
Deposited from Sr overstoichiometric targets

Deposited from stoichiometric targets

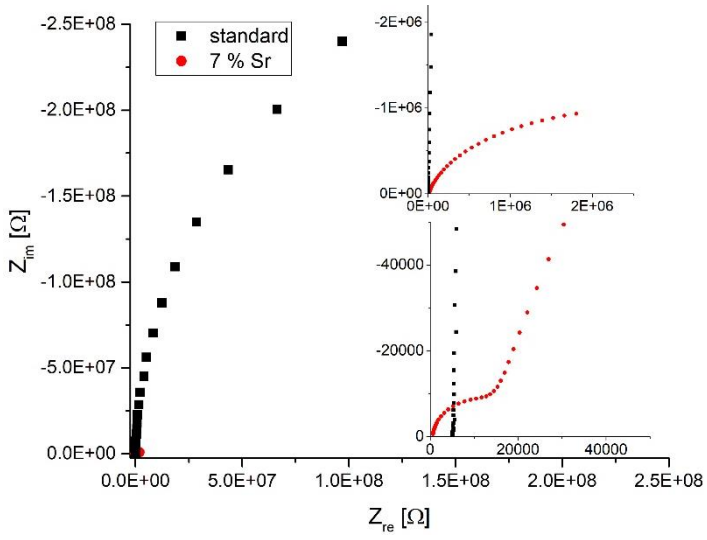
Conductivity measurements

By means of Electrochemical Impedance Spectroscopy

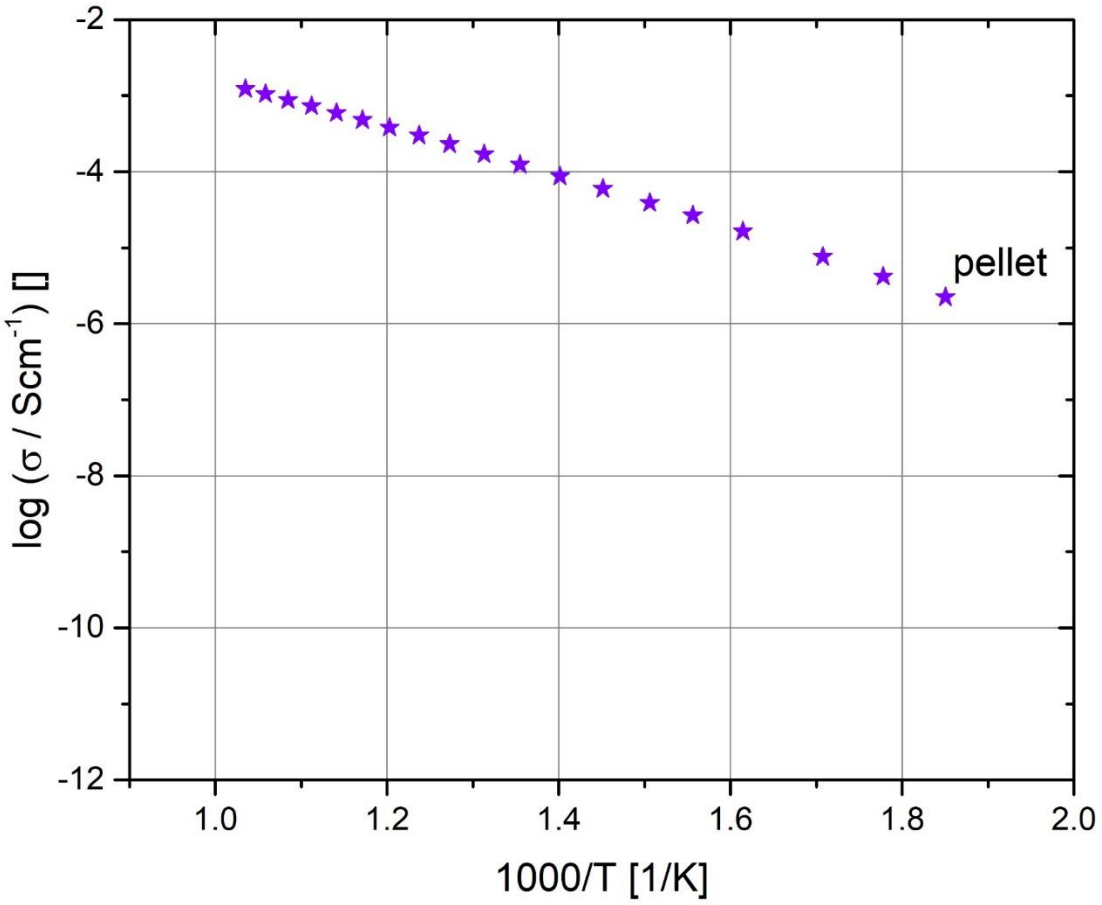




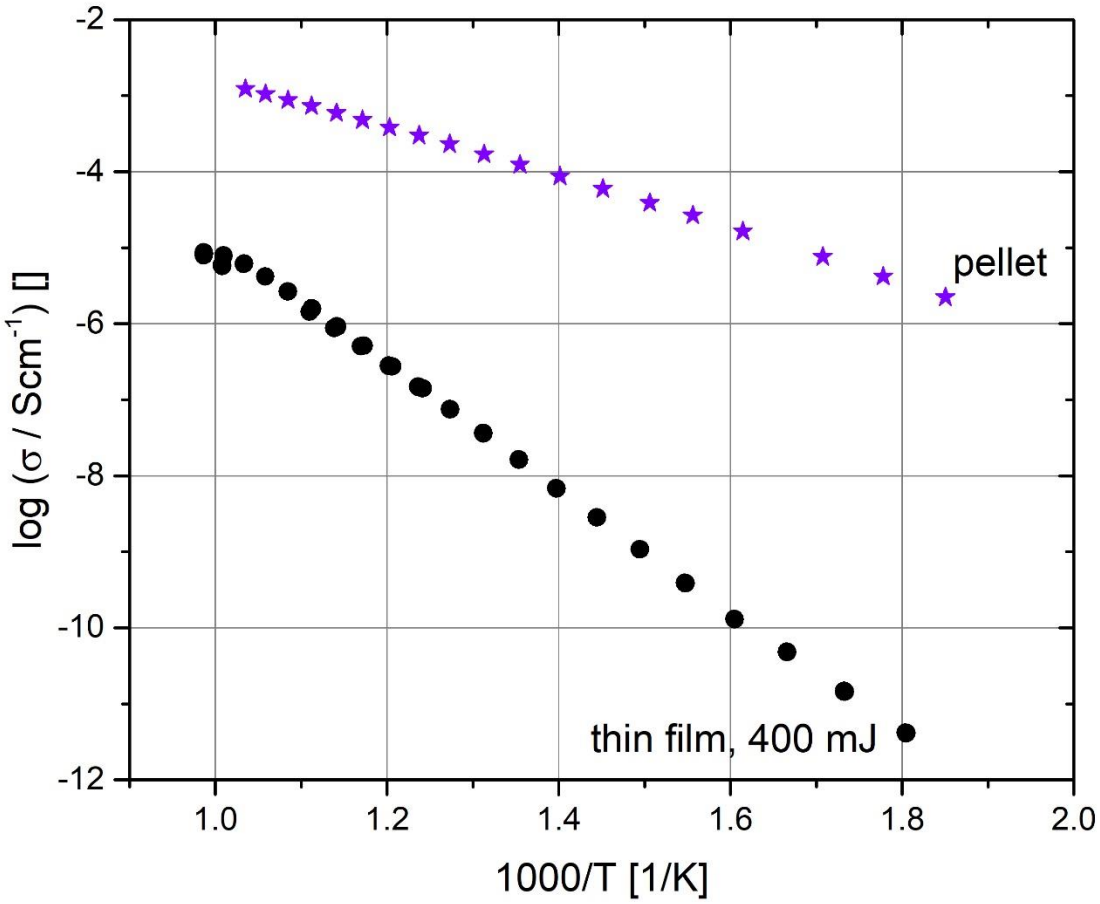
Nyquist Plot 300 °C



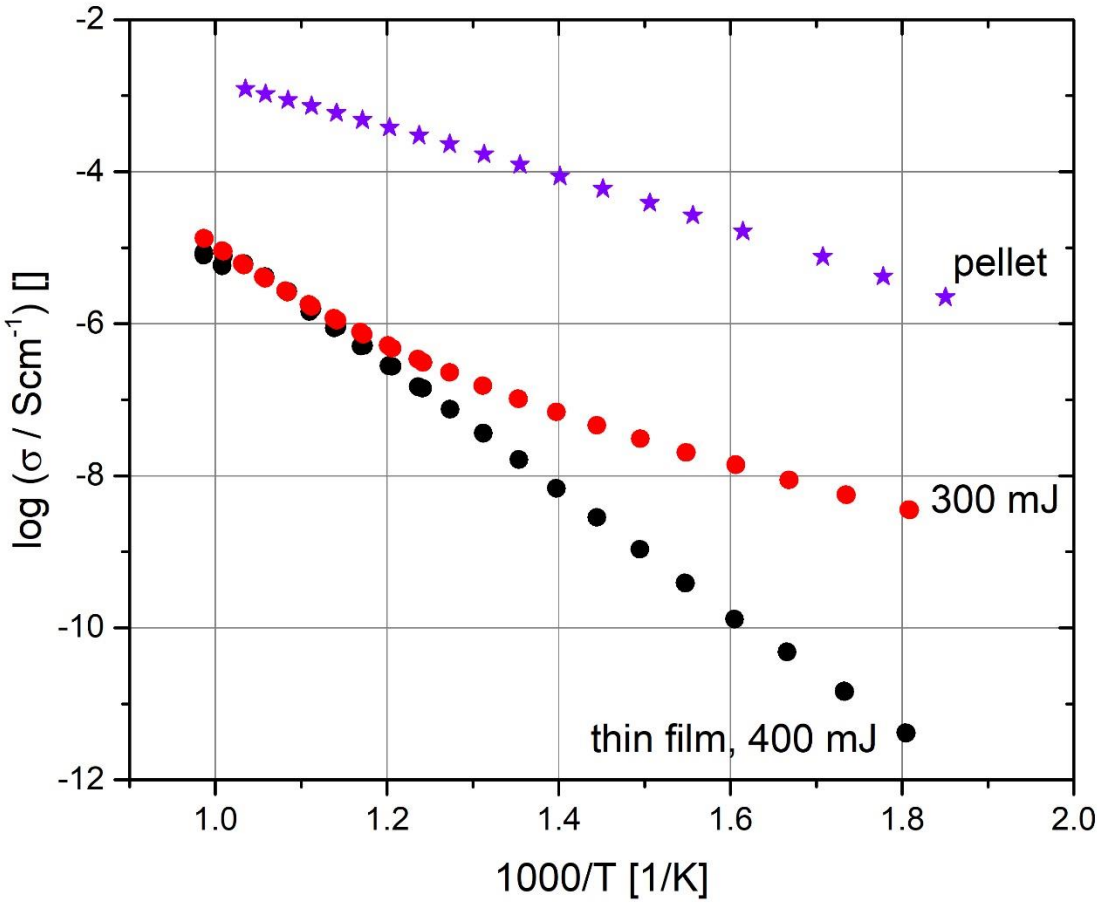
Conductivity



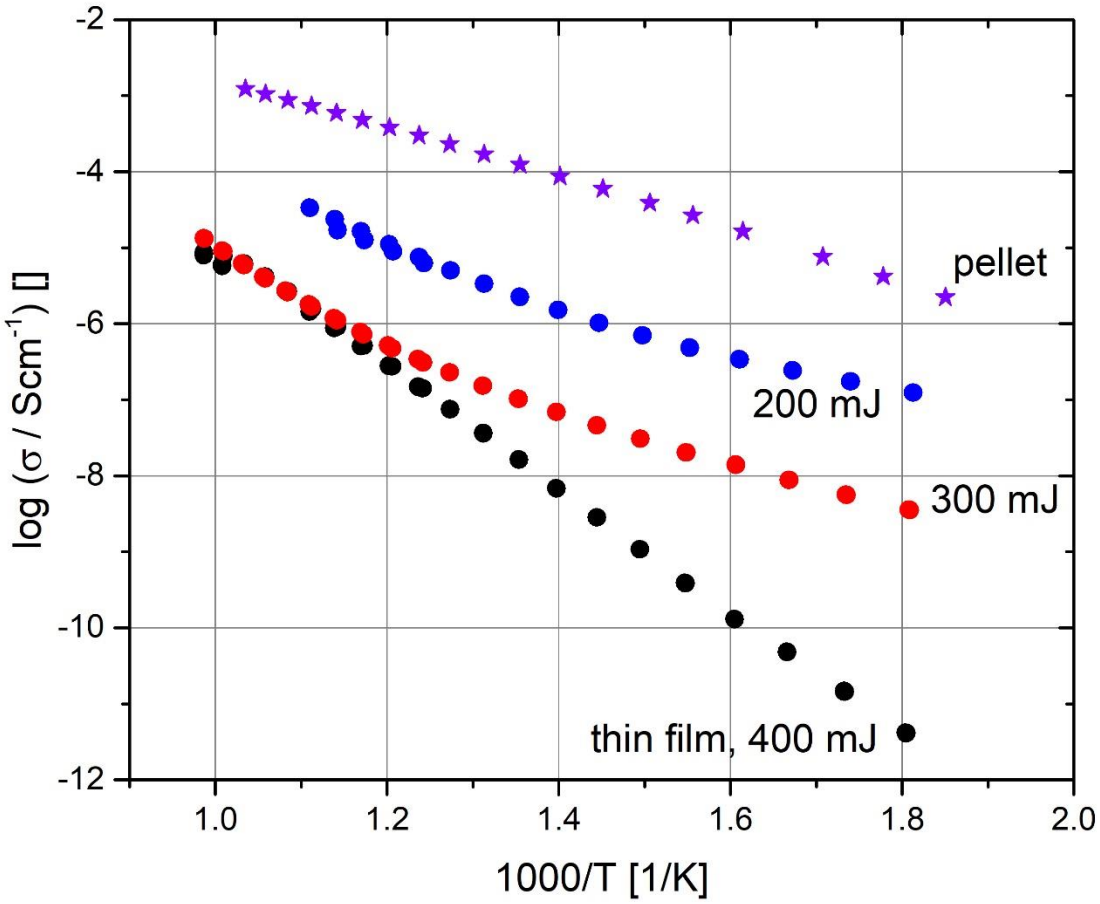
Conductivity



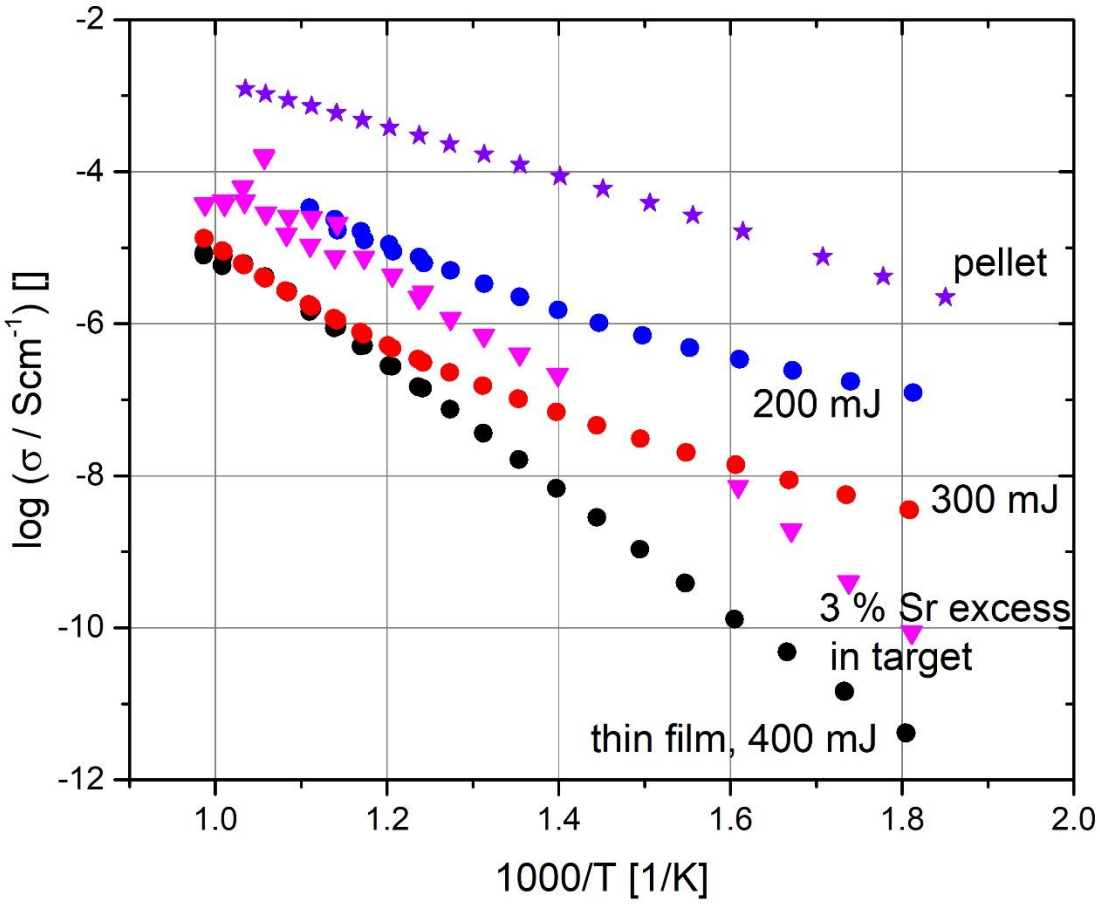
Conductivity



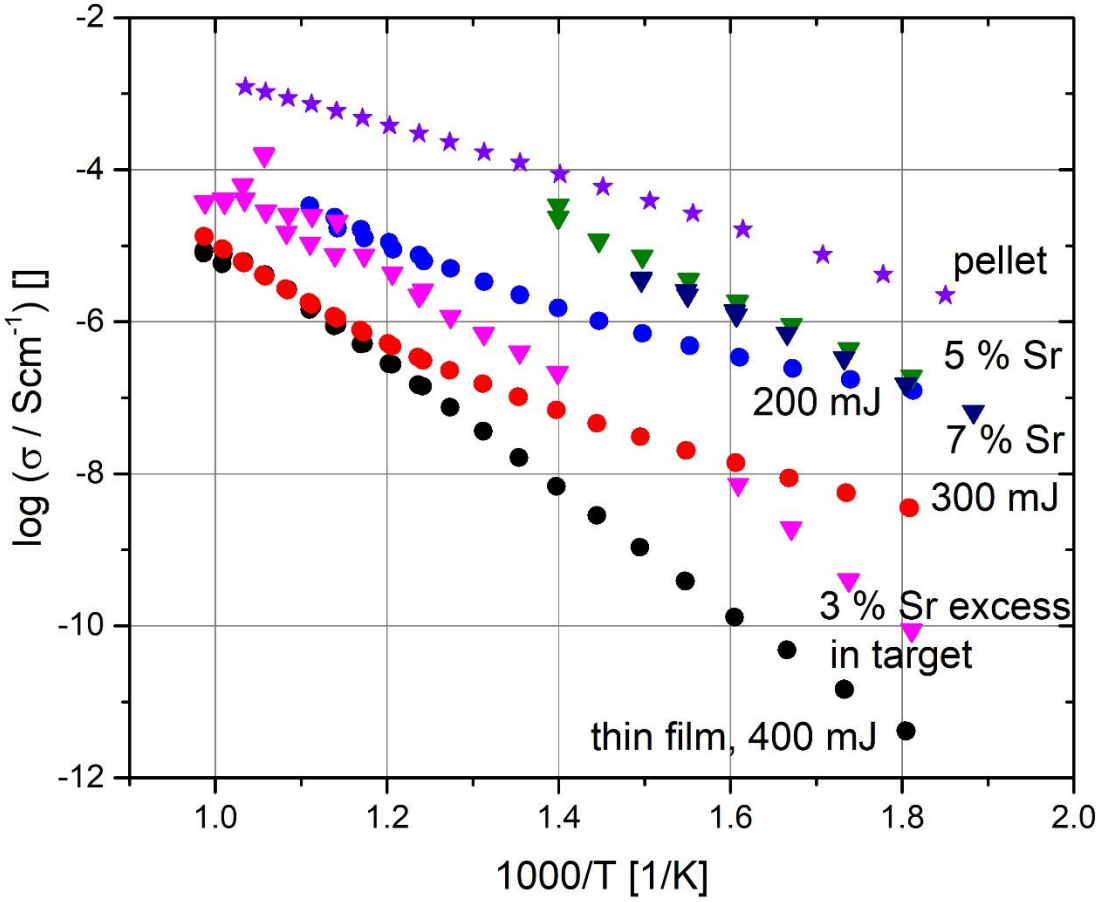
Conductivity



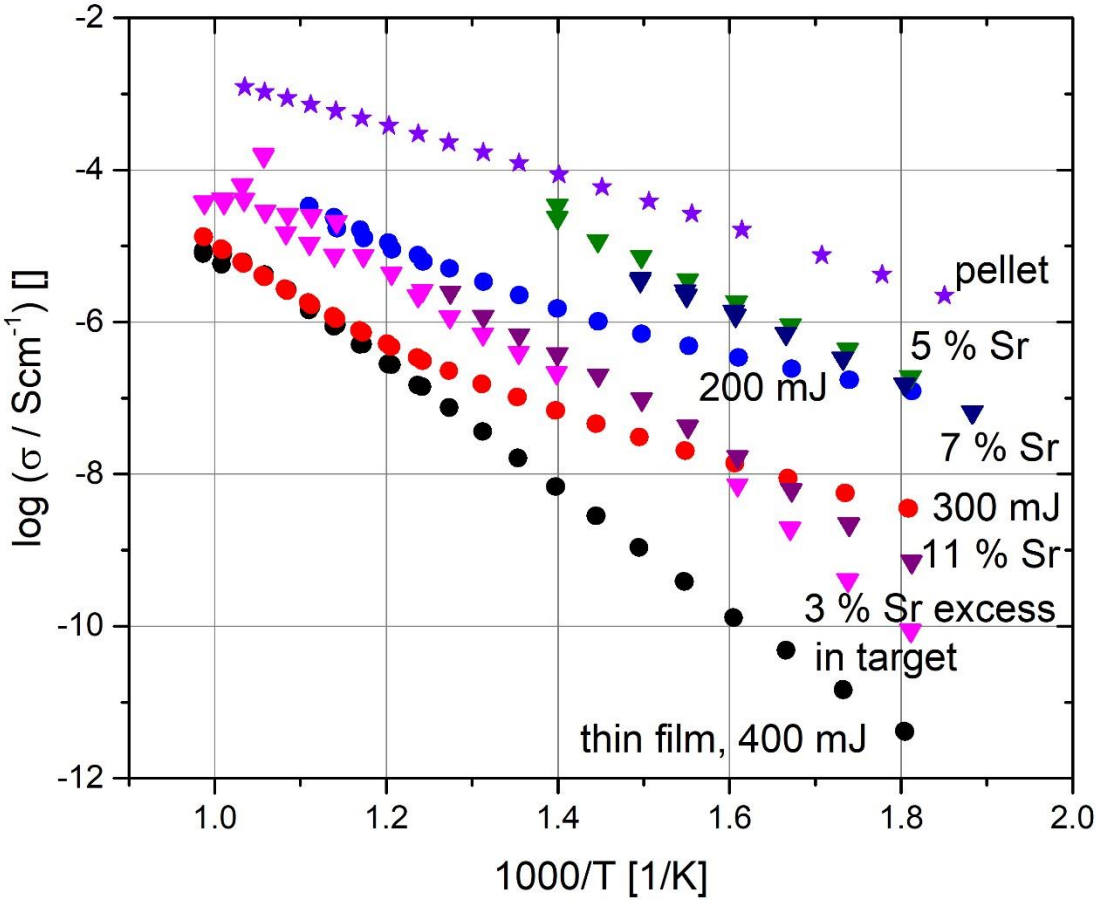
Conductivity



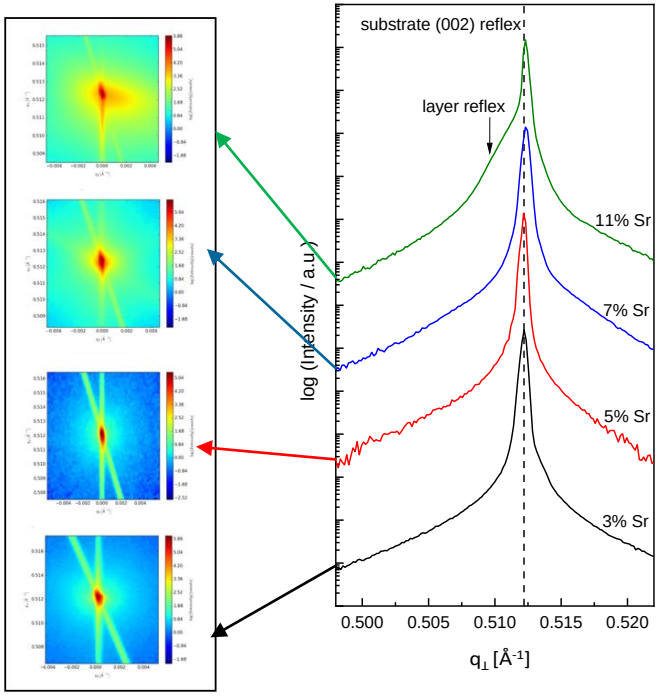
Conductivity

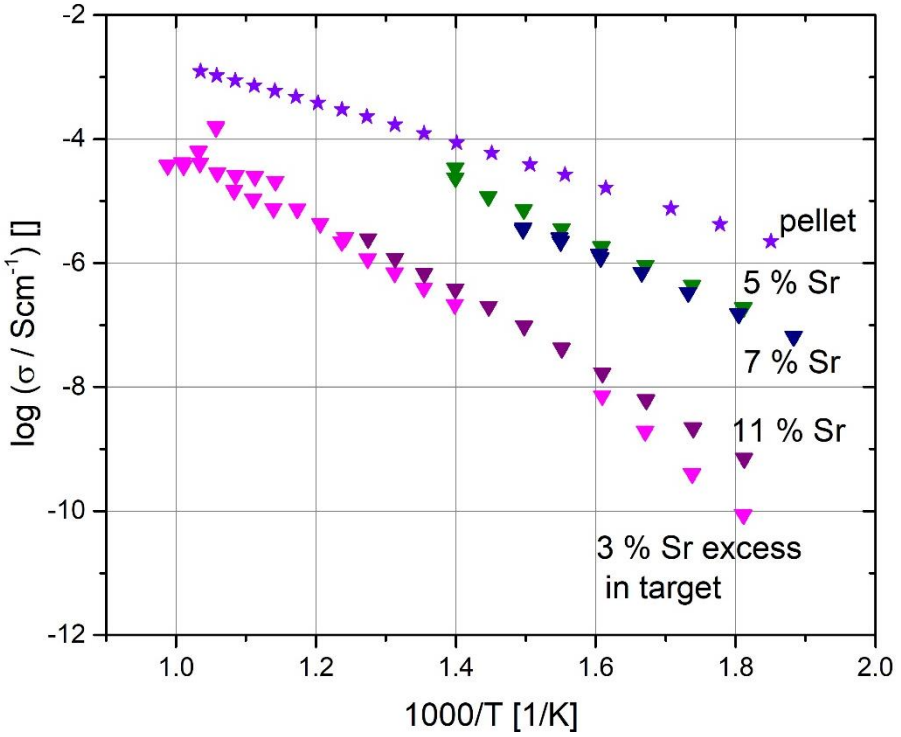


Conductivity

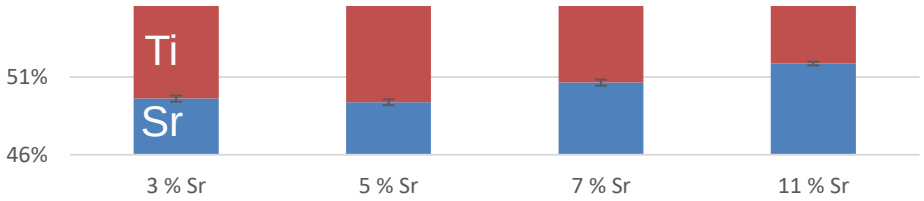


Structure vs. Conductivity

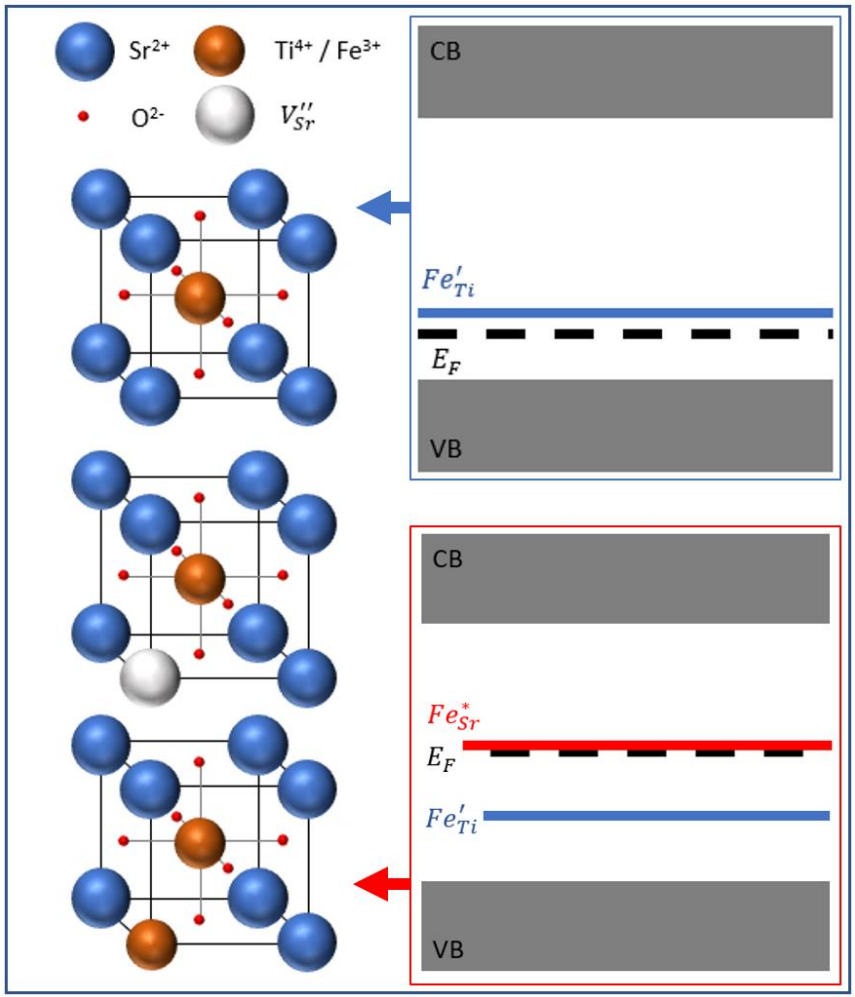




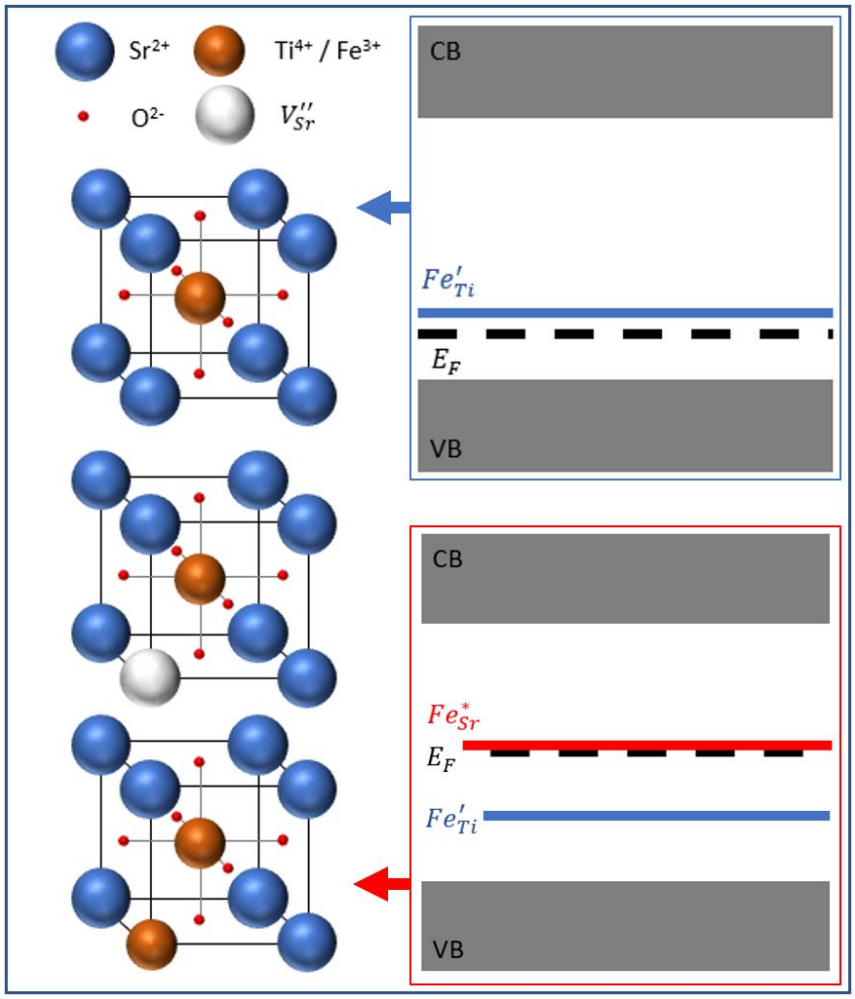
Structure and conductivity for thin films deposited from targets with a Sr overstoichiometry



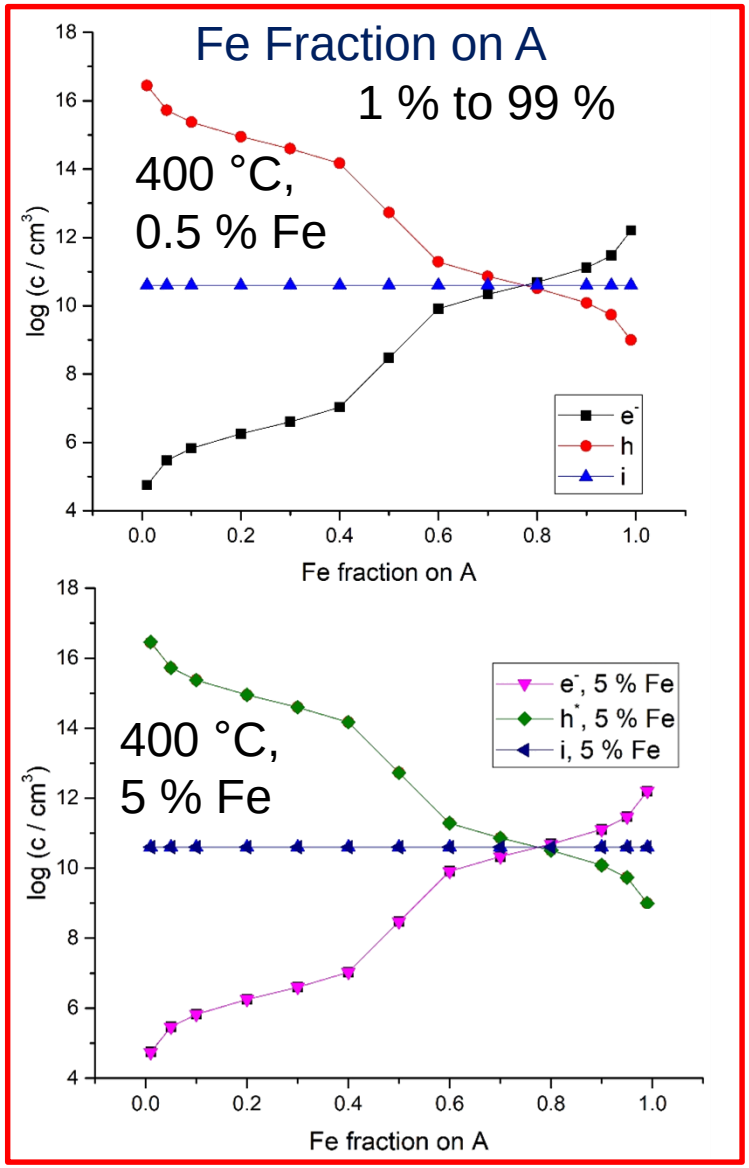
Model



Model

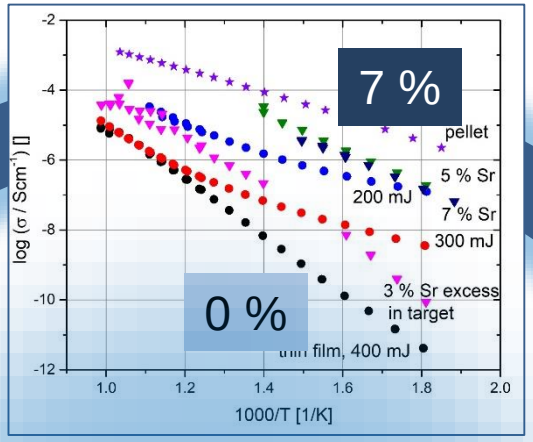


Denk, et al., J. Am. Ceram. Soc.

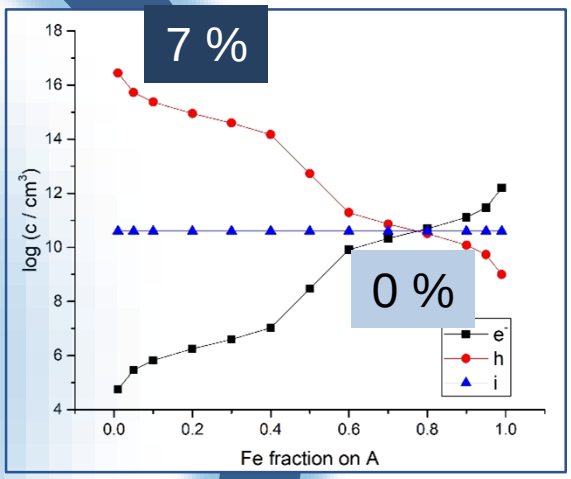


Discussion

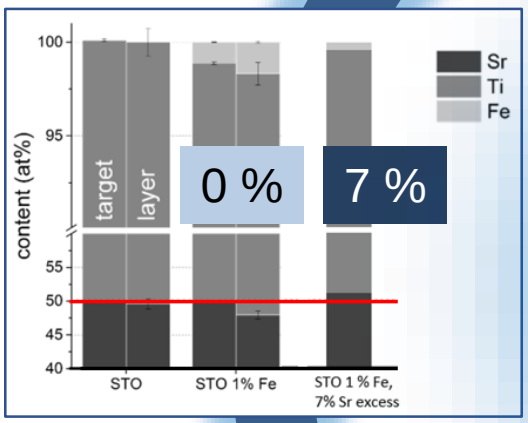
5. σ



4. Charge carrier concentration



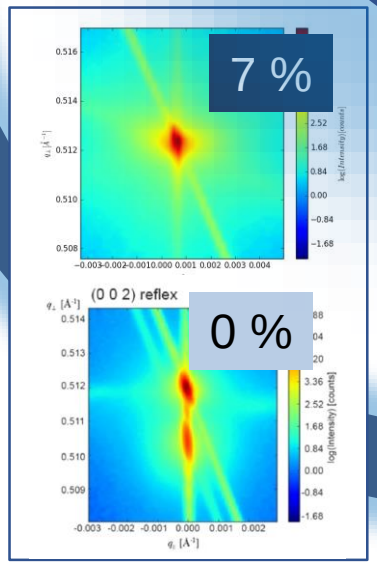
1. ICP-OES

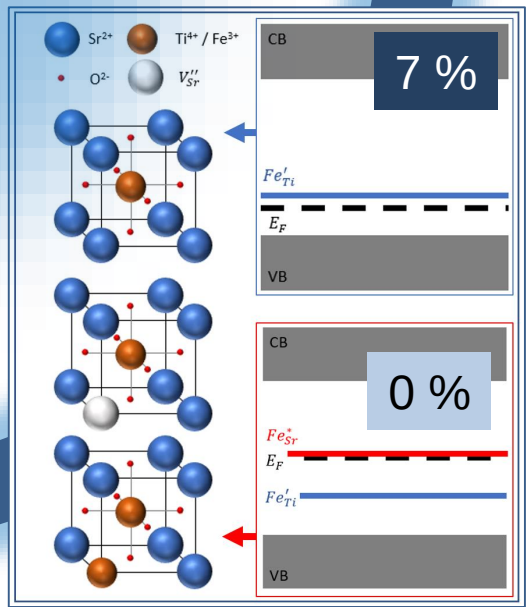


Composition

Properties

Structure





3. Band model

Fe:STO with Sr excess:

0 %

7 %

2. XRD

Thank you for your attention!