Investigation of the Conductivity in Li-Mn-O Thin Films

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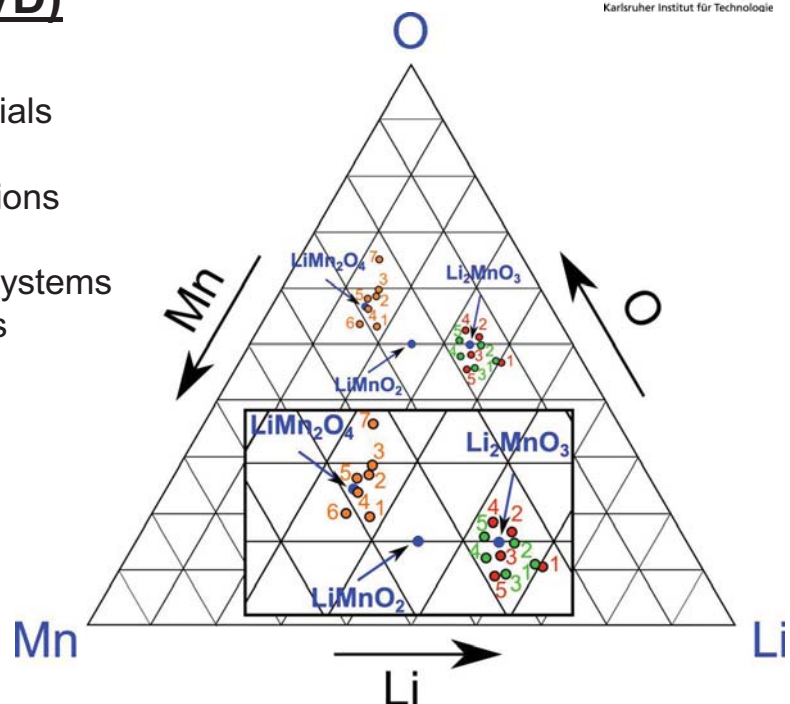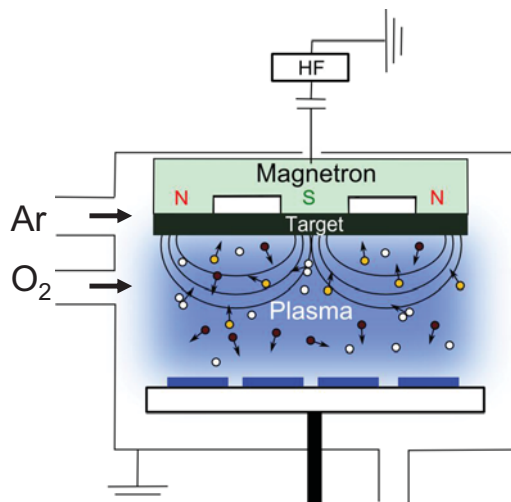INSTITUT FÜR ANGEWANDTE MATERIALIEN– ANGEWANDTE WERKSTOFFPHYSIK (IAM-AWP)

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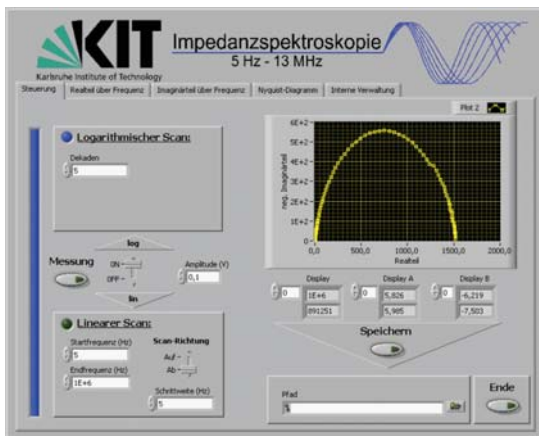

Thin Film Synthesis (PVD)

R.F. Magnetron Sputtering

- Synthesis of pure active materials
- Combinatorial target approach
- Synthesis of different constitutions and microstructures
- Ideal two-dimensional model systems
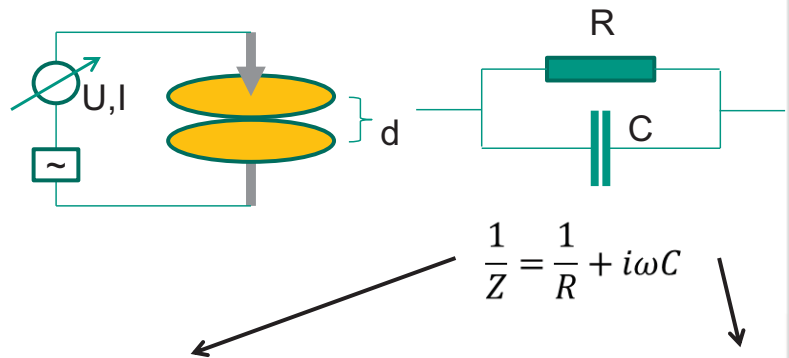- → Determination of Conductivities

Determination of the Li-Mn-O Conductivity

Impedance Spectroscopy

$$\hat{Z}(\omega) = Z'(\omega) + iZ''(\omega) \qquad \sigma'(\omega) = \frac{d}{S} \cdot \frac{Z'}{|\hat{Z}|^2}$$

$$\hat{\sigma}(\omega) = \frac{d}{\hat{Z}(\omega) \cdot S} \qquad \sigma''(\omega) = -\frac{d}{S} \cdot \frac{Z''}{|\hat{Z}|^2}$$
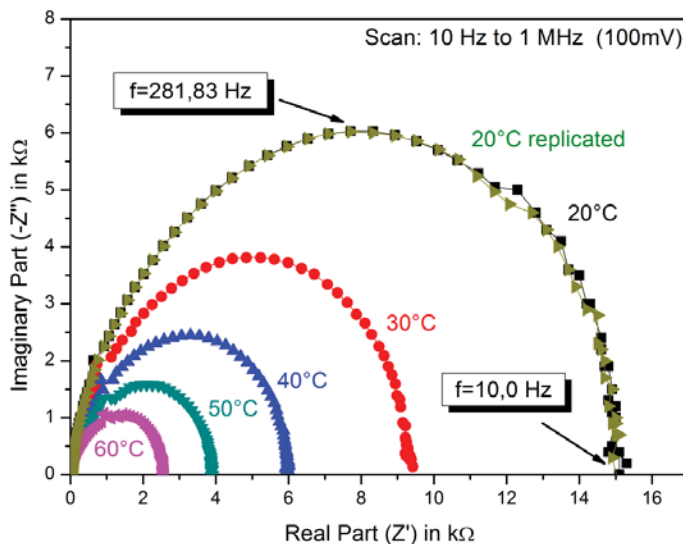
$$\frac{1}{Z} = \frac{1}{R} + i\omega C$$

$$\sigma'(\omega \approx 0) = \sigma_{dc} = \frac{d}{S} \cdot \frac{1}{R} \qquad\qquad \sigma''(\omega) = \omega \cdot C \cdot \frac{d}{S}$$

Model System LiMn$_2$O$_4$

Measured Conductivities:

T [°C]	σ_{dc} [Scm^{-1}]
20	$1.31*10^{-7}$
30	$2.15*10^{-7}$
40	$3.38*10^{-7}$
50	$5.18*10^{-7}$
60	$7.79*10^{-7}$

$E_a = 0.401$ eV

E_a (eV)	Literature
0.44 / 0.42	Iguchi, J.A. Phys. 2002; Vol. 91
0.3 - 0.5	Molenda, Solid. S. Ion. 1999; Vol. 123
0.42	Hussain, Ionics 2007; Vol. 13
0.4 - 0.45	Guan, S.S. Ionics 1998; Vol. 110