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

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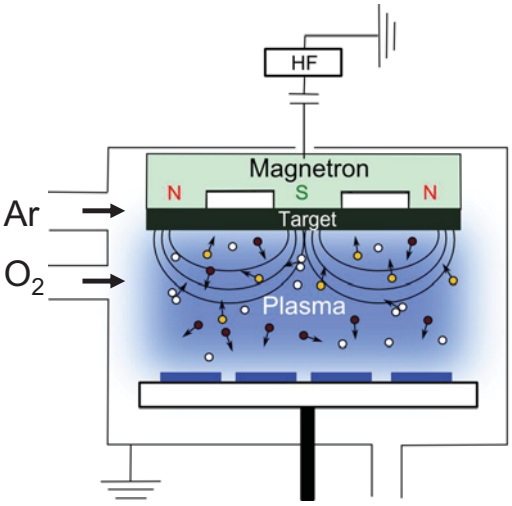
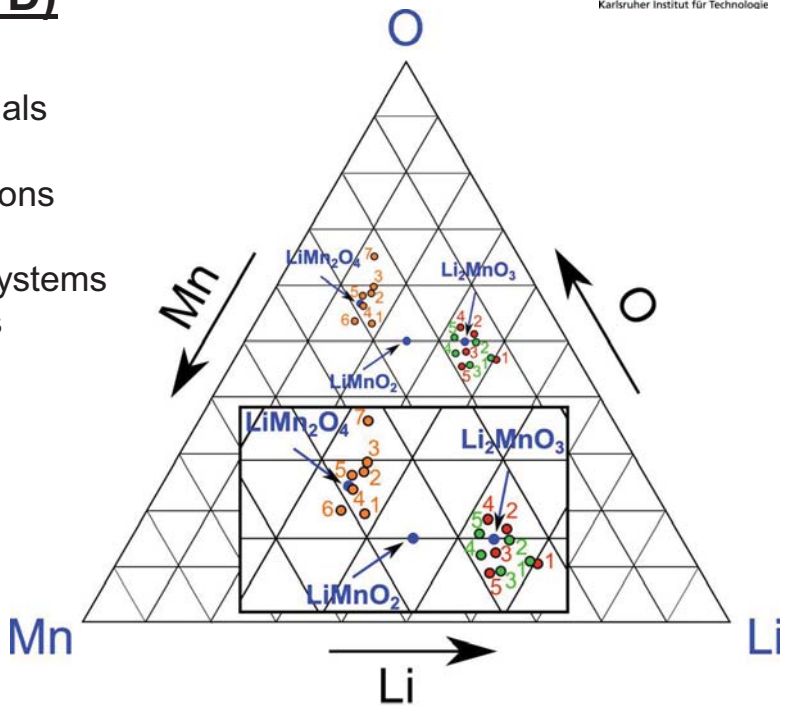
## Thin Film Synthesis (PVD)

### R.F. Magnetron Sputtering

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

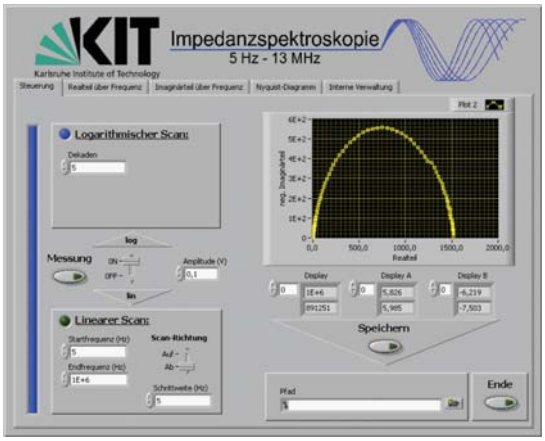
→ Determination of Conductivities



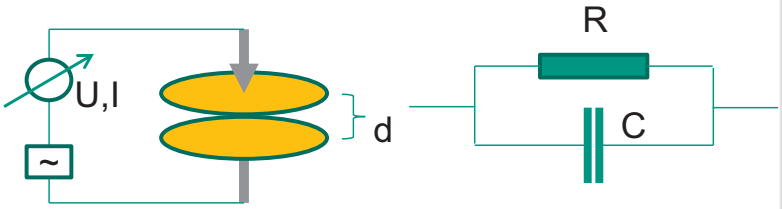
# Determination of the Li-Mn-O Conductivity

## Impedance Spectroscopy




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

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

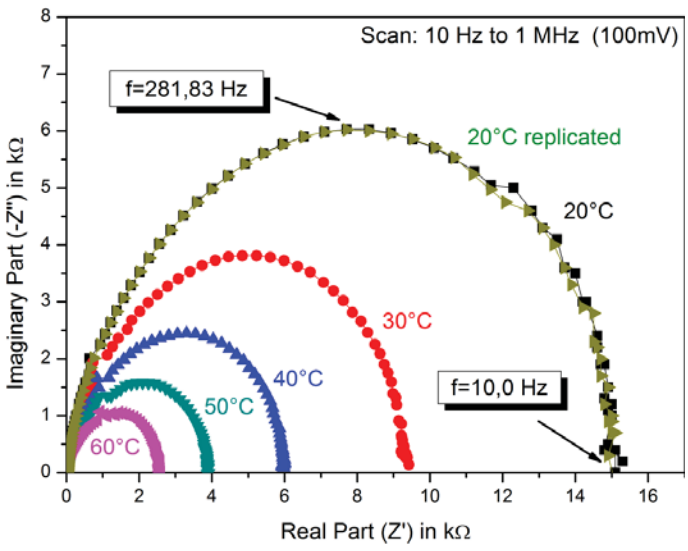



$$\frac{1}{Z} = \frac{1}{R} + i\omega C$$

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



# Model System $LiMn_2O_4$




| $E_a$ (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 |

Measured Conductivities:

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