# Rapid Thermal Processing of screen-printed $LiCoO_2$ Films

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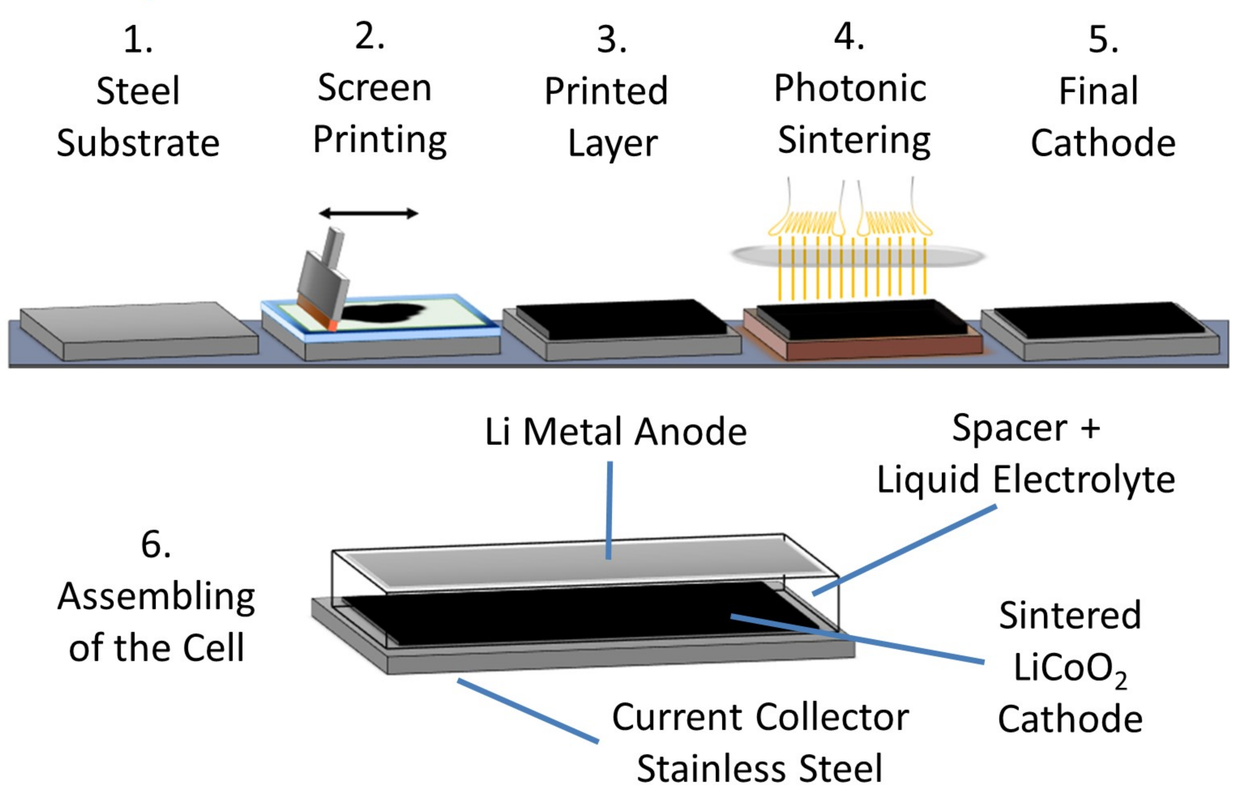
## Introduction

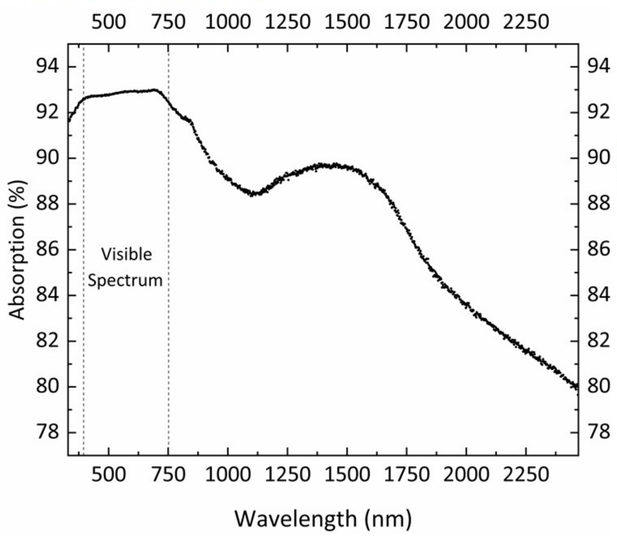
The ongoing development of materials and process routes of thin film electrodes for the use in micro batteries offers the possibility to enable and optimize energy storage systems for special applications [1]. Advantageous for these type of cells are in addition to their low weight and size, the easy adaption to the device geometry and higher charge-discharge rates compared to bulk electrodes [2]. A suitable cathode material for film applications is $LiCoO_2$ (LCO) [3]. A process for the film fabrication is screen-printing, which enables a fast and economic layer production. The printed layers need a densification step, usually linked to a heat treatment with conventional furnaces with slow heating rates and usually long holding times. A faster alternative is sintering with light, known as photonic sintering, enabling rapid process routes.

We present an applicability test of such a photonic sintering with Rapid Thermal Processing (RTP) for the densification of screen-printed LCO films on stainless steel substrates, which act as a current collector and provide mechanical strength.

## Experimental

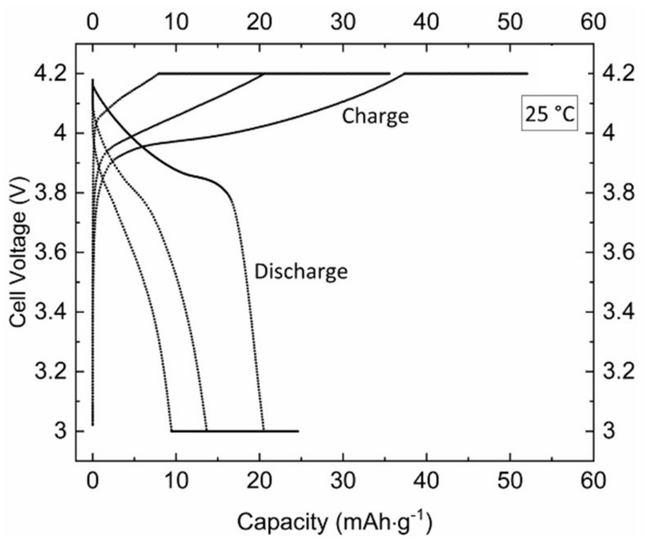



## Results



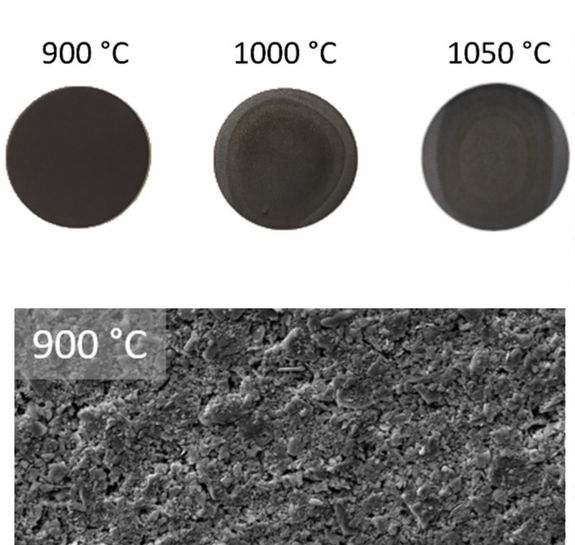

**Optical Absorption**

- High absorption prior to sintering
- High energy transfer possible during RTP



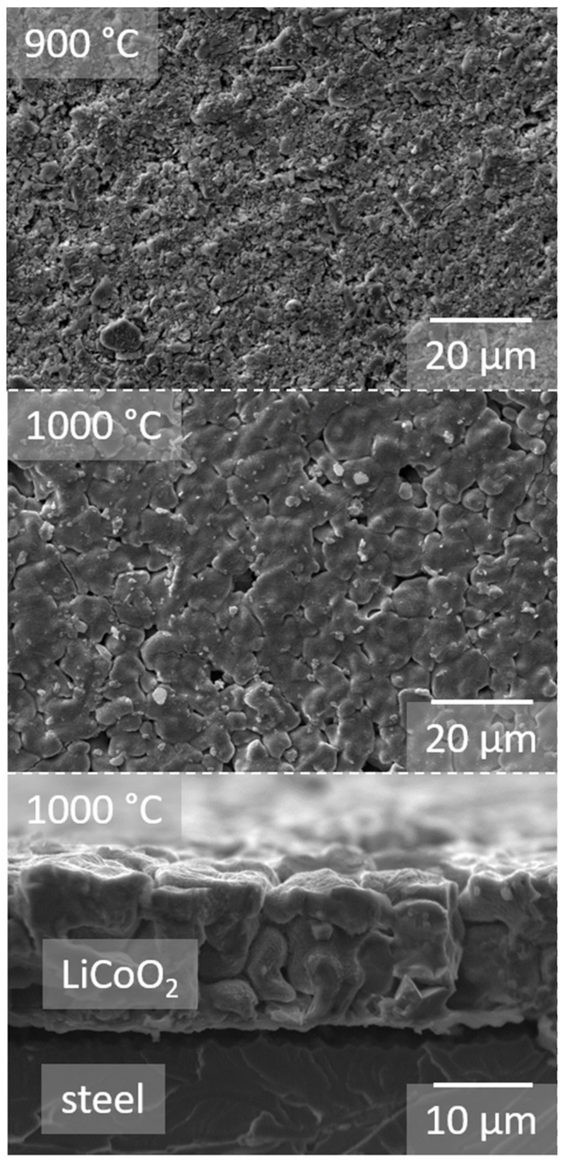

**Electrochemistry** [4]

- Cathode is electrochemical active
- Low discharge capacity (LCO 140 mAh g$^{-1}$)
- Strong degradation




**Sample Photo**

- The Surface is changing at 1000 °C
- This indicates a sintering process
- Samples show a circular shape




**Microstructure**

- At 900 °C no sintering observable
- Sintering is occurring at 1000 °C
- Sintering over the complete layer

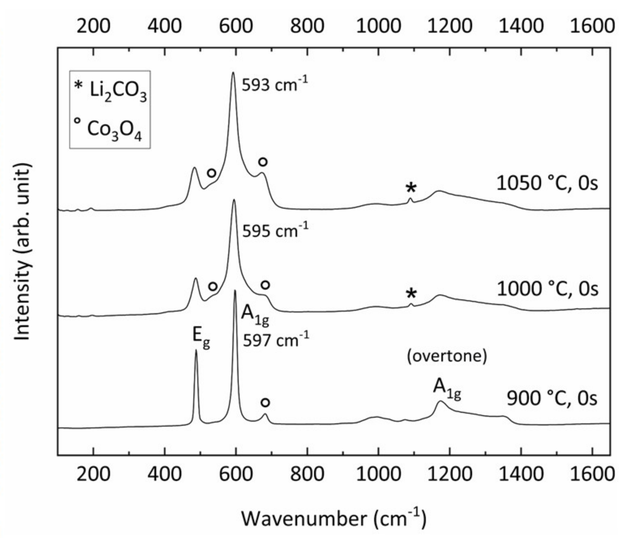
**Phase Analysis** [5]

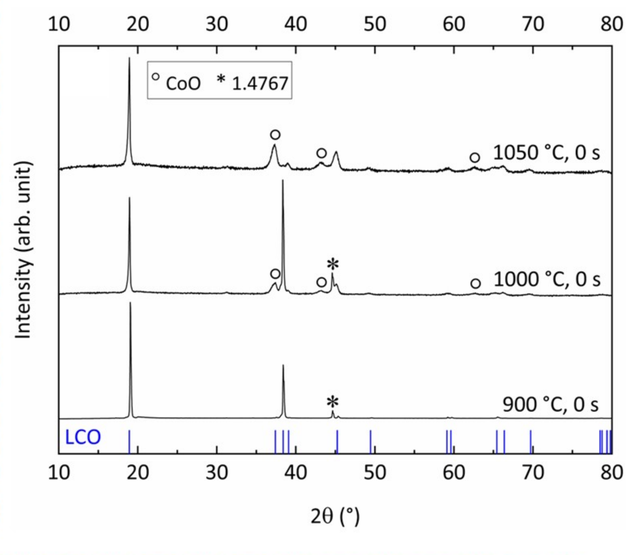
➢ **Raman spectroscopy**

- LCO phase is present until 1050 °C
- At high temperatures shift to lower wavenumbers
- This indicates a loss of Li in the LCO phase

➢ **X-ray diffraction**

- LCO phase is present until 1050 °C
- More Co oxides at higher temperature




## Summary

LCO films were fabricated by screen-printing and photonic sintering (RTP) on an EN 1.4767 steel substrate using the high absorption of LCO. The sintering was done at 1000 °C with minor secondary phases of Co oxides. Electrochemical activity could be proven by cell tests with a liquid electrolyte, however with a low capacity due to the low ionic conductivity of LCO and the high thickness of the cathode.

## References

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