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Impregnation of FeCrAl porous metallic support by dipcoating technique for MS-IT-SOFC applications

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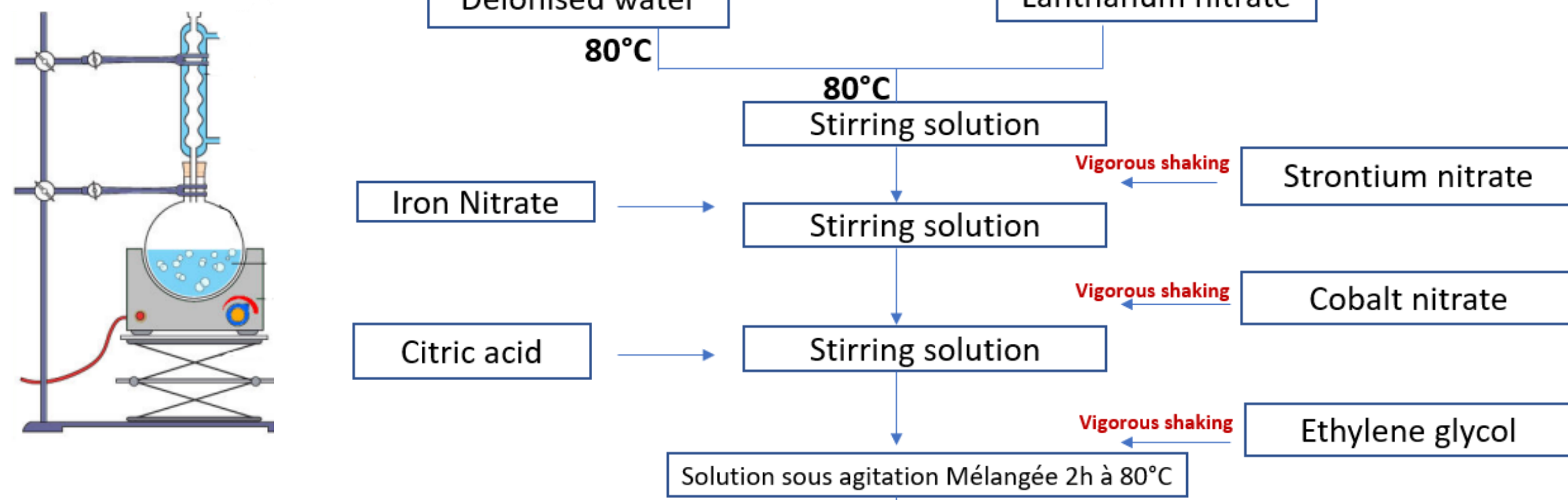
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Introduction

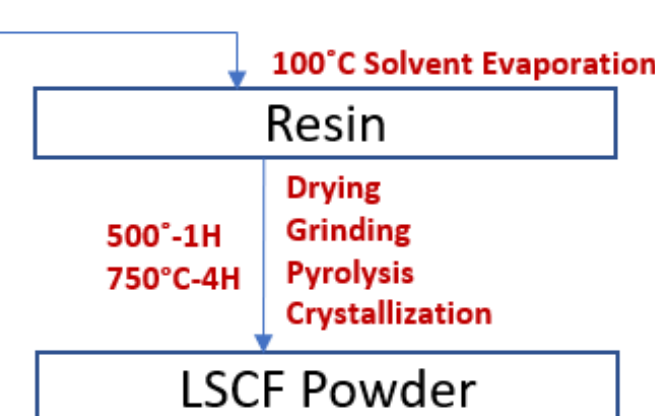
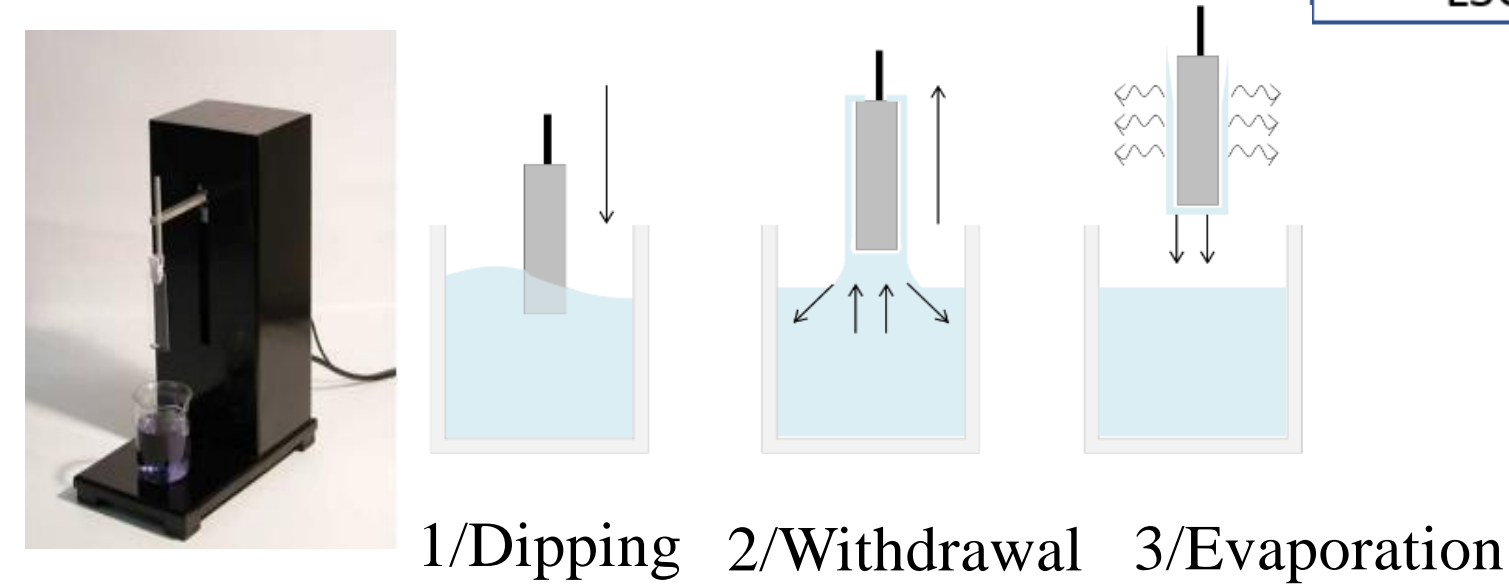
Metal-Supported Intermediate-Temperature Solid Oxide Fuel Cells at (MS-IT-SOFCs) have the potential to become a key technology for future energy systems. In this work we demonstrate that sol-gel solutions can be used for the impregnation of FeCrAl supports to avoid the oxidation of the support at high temperature. The goal is clearly to improve the durability of the anodic support, and thus of the fuel cell. This study focuses on the use of $(La_{0.6}Sr_{0.4}Co_{0.8}Fe_{0.2}O_3)$, $(Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_3)$, $(LaNi_{0.6}Fe_{0.4}O_3)$ and $(La_{0.75}Sr_{0.25}Cr_{0.5}Mn_{0.5}O_3)$ solutions synthesized by the sol-gel method. The FeCrAl supports were impregnated with sol gel solutions by dip-coating technique to protect the metal fibers of the support from corrosion in the MS-IT-SOFC application at three different temperatures (500 °C, 600 °C and 700 °C).

Experimental

Sol-gel synthesis:

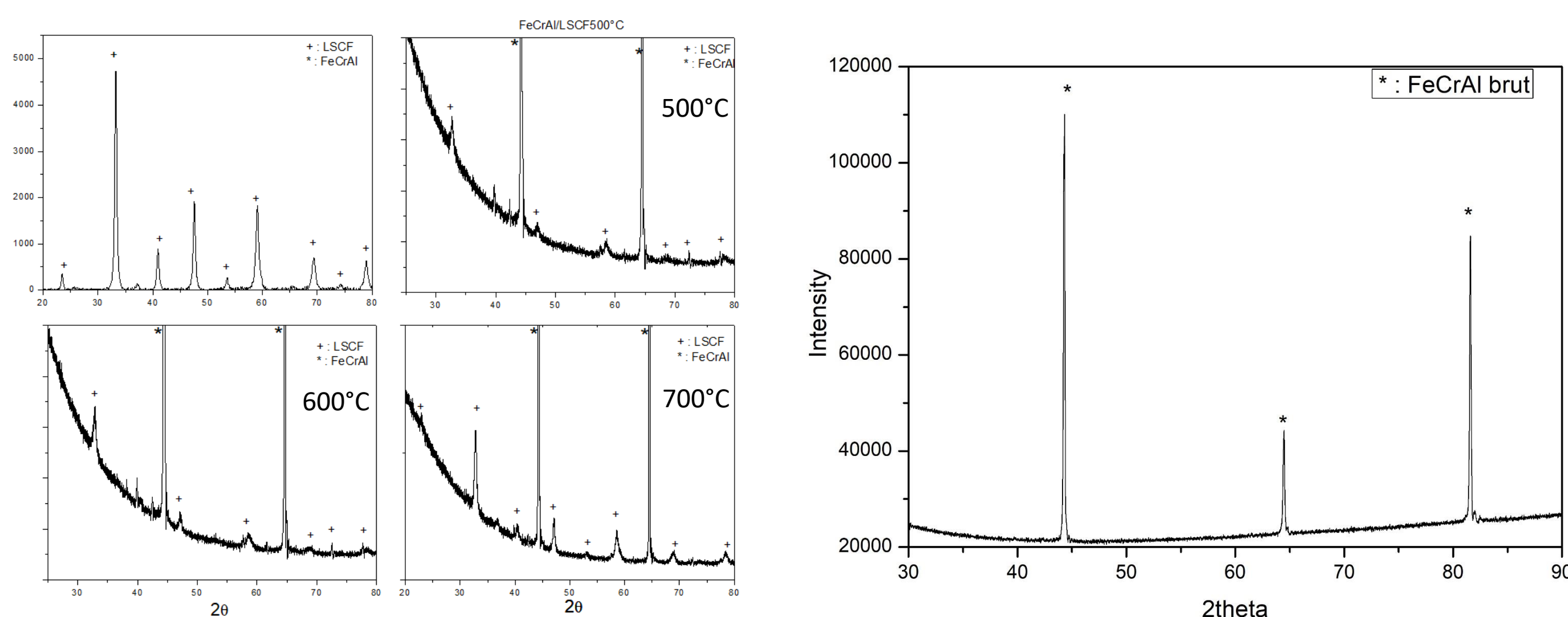


Dip-Coating Process:

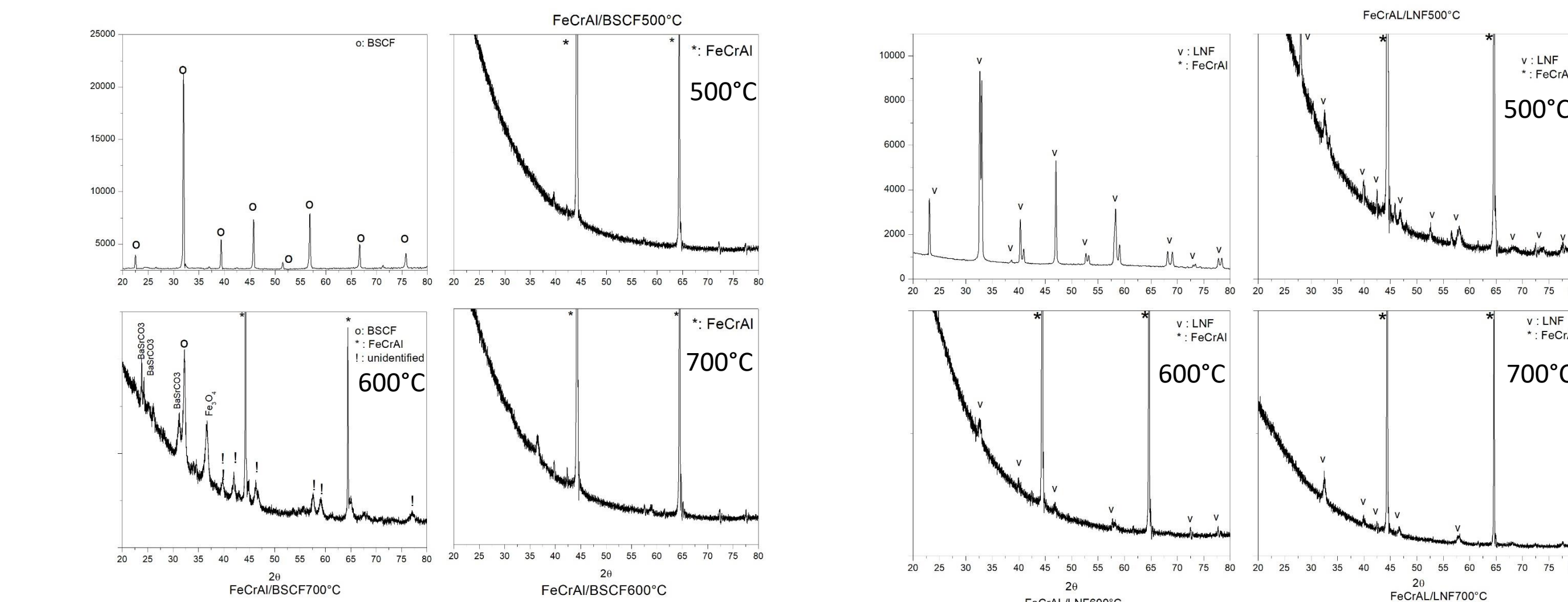


- Impregnation of metallic support by dipcoating method into sol-gel solutions (5/10/15 soakings)

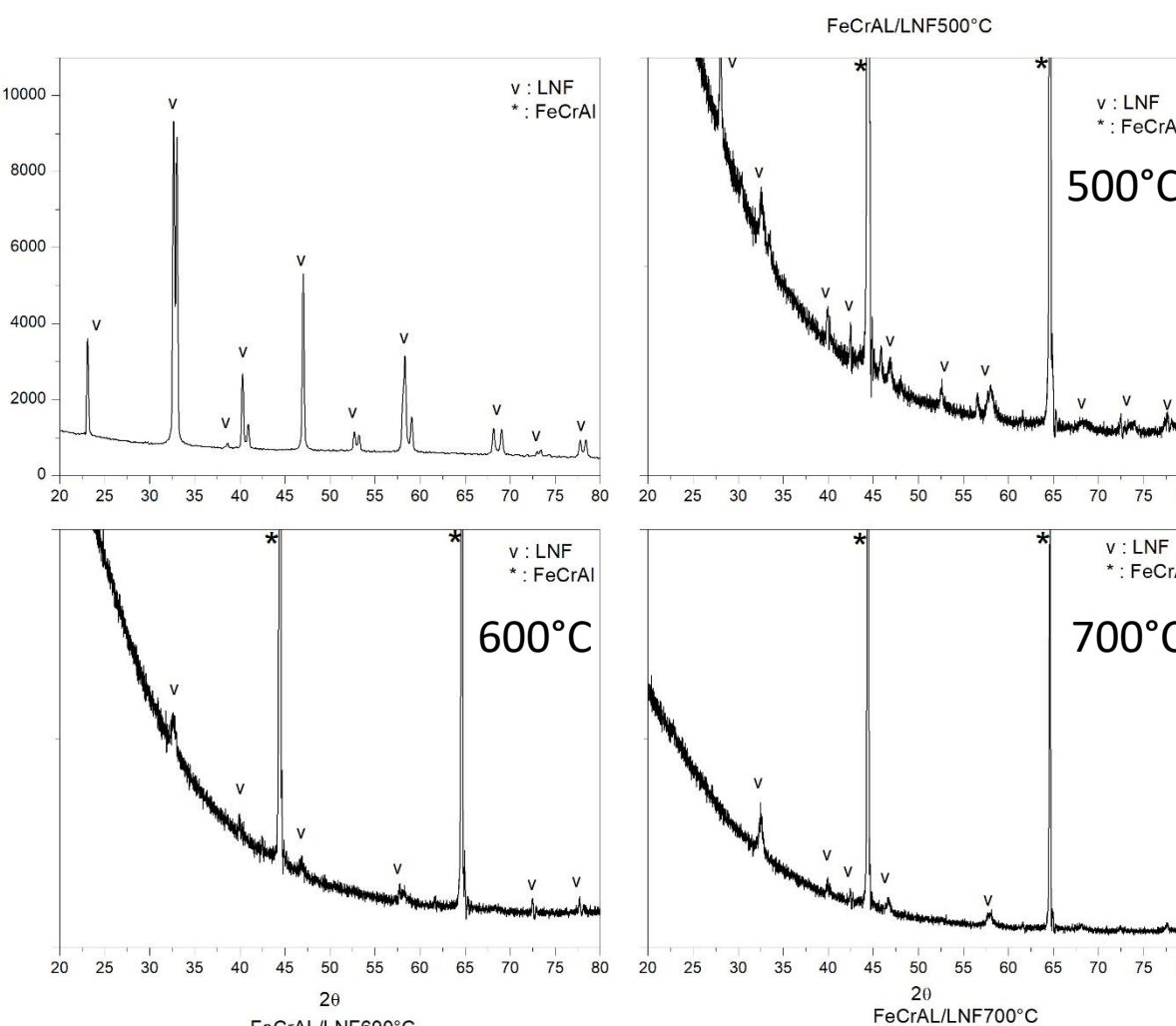
Structural Characterization - XRD



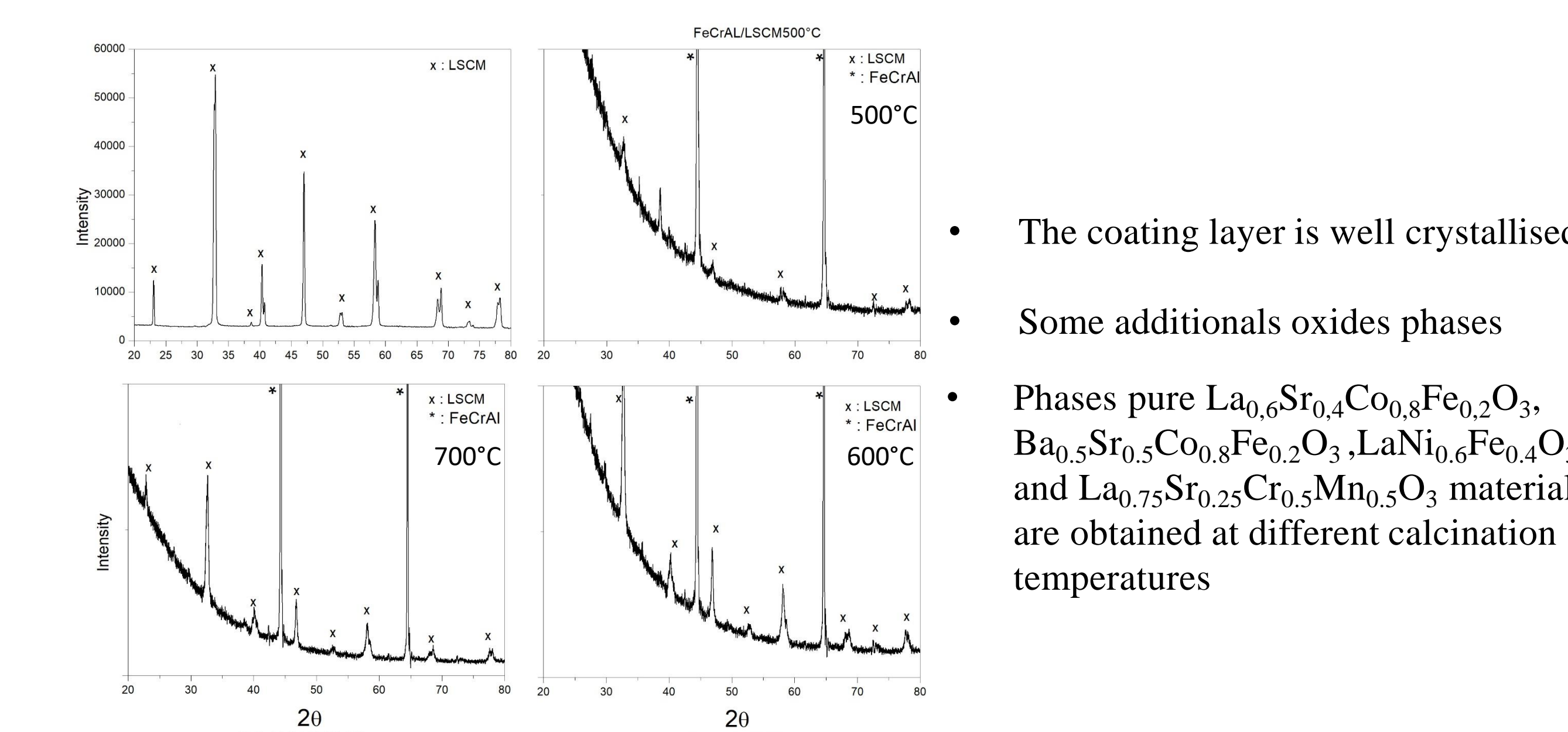
FeCrAl support impregnated into LSCF solution at 500°C/600°C/700°C



FeCrAl support impregnated into BSCF solution at 500°C/600°C/700°C



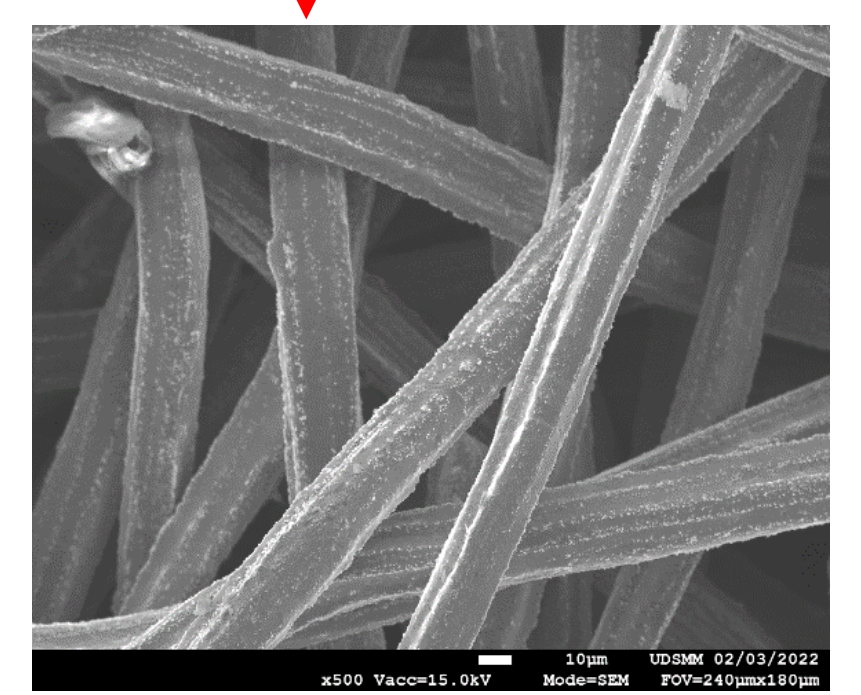
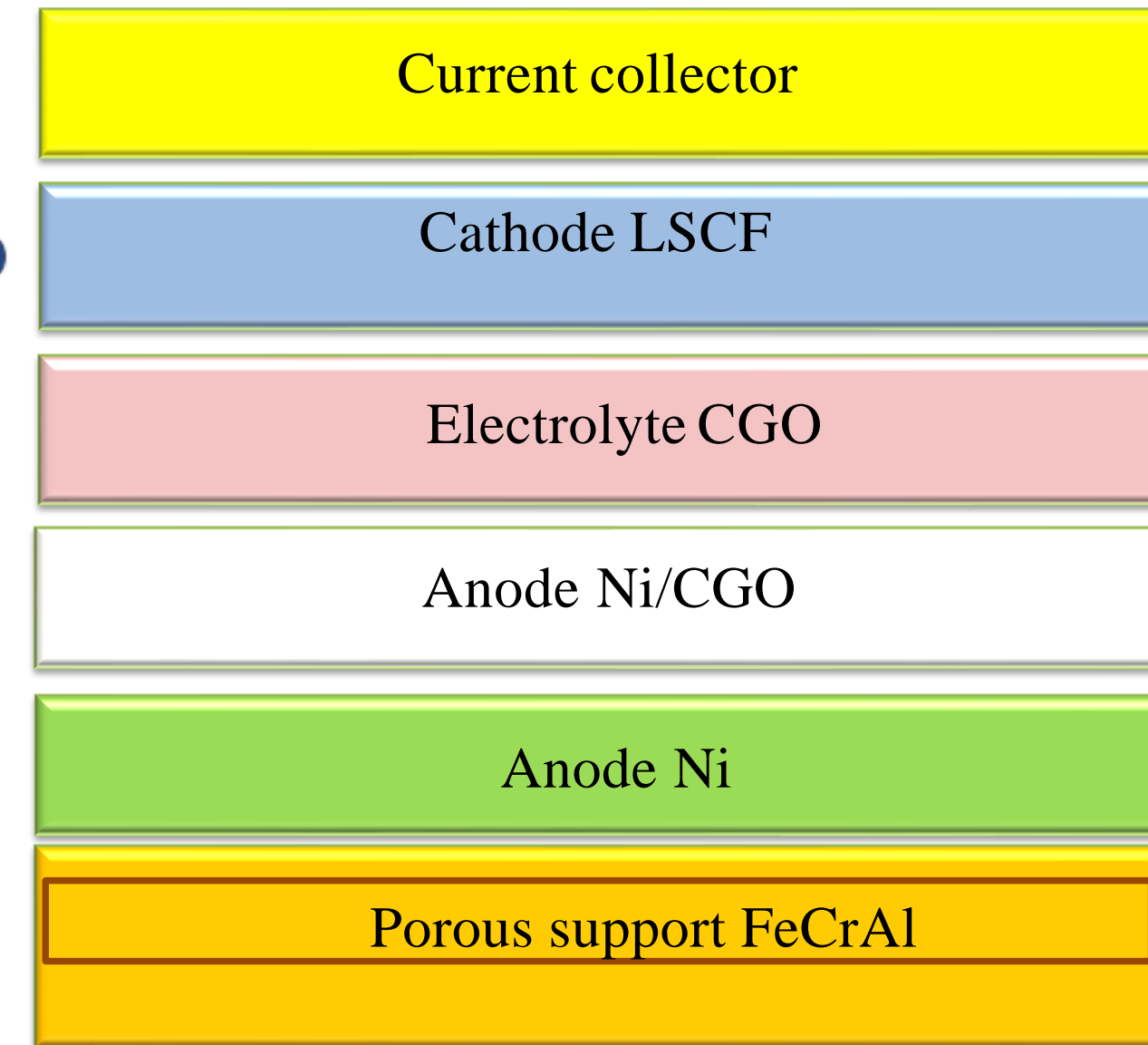
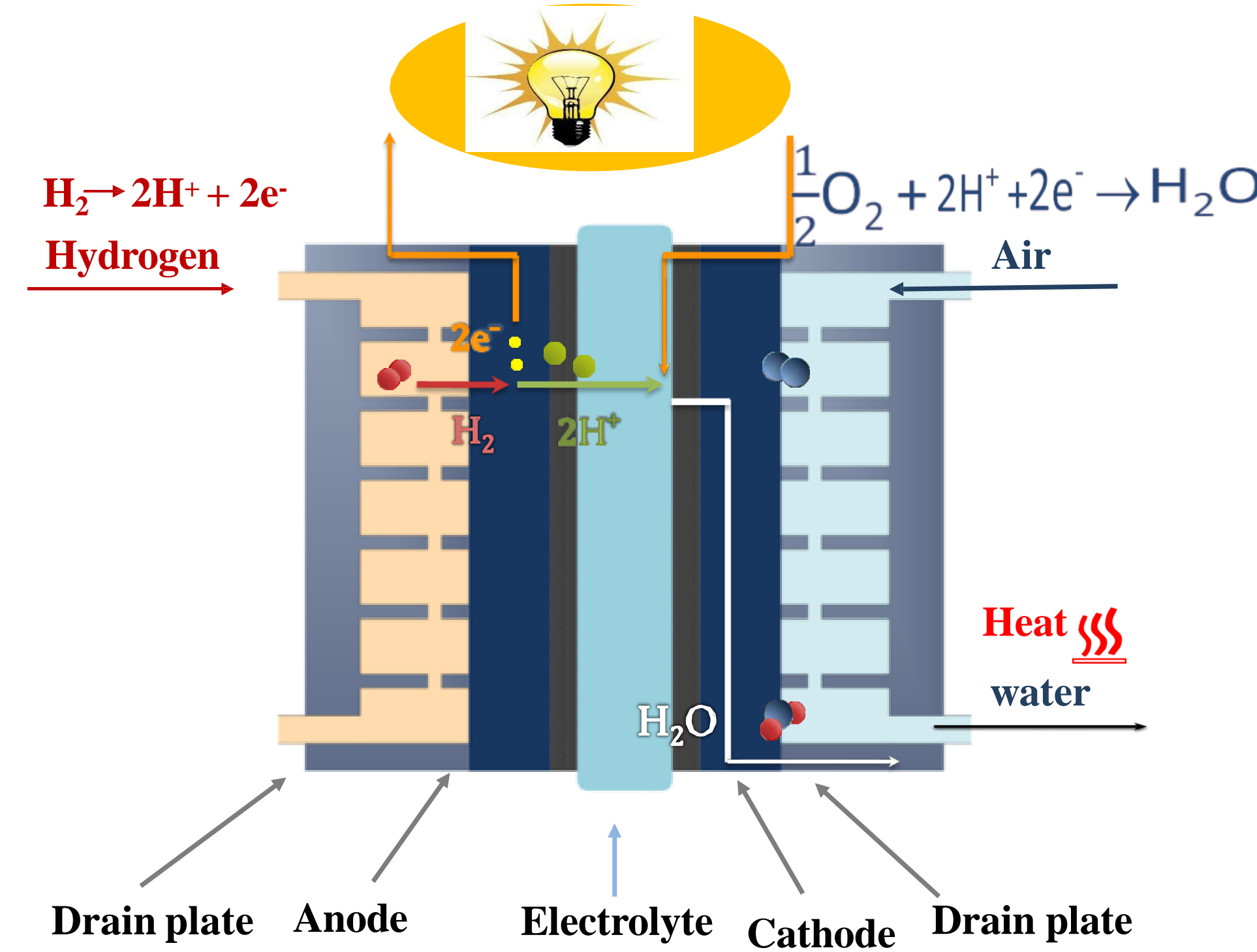
FeCrAl support impregnated into LNF solution at 500°C/600°C/700°C



FeCrAl support impregnated into LSCM solution at 500°C/600°C/700°C

- The coating layer is well crystallised
- Some additional oxides phases
- Phases pure $La_{0.6}Sr_{0.4}Co_{0.8}Fe_{0.2}O_3$, $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_3$, $LaNi_{0.6}Fe_{0.4}O_3$ and $La_{0.75}Sr_{0.25}Cr_{0.5}Mn_{0.5}O_3$ materials are obtained at different calcination temperatures

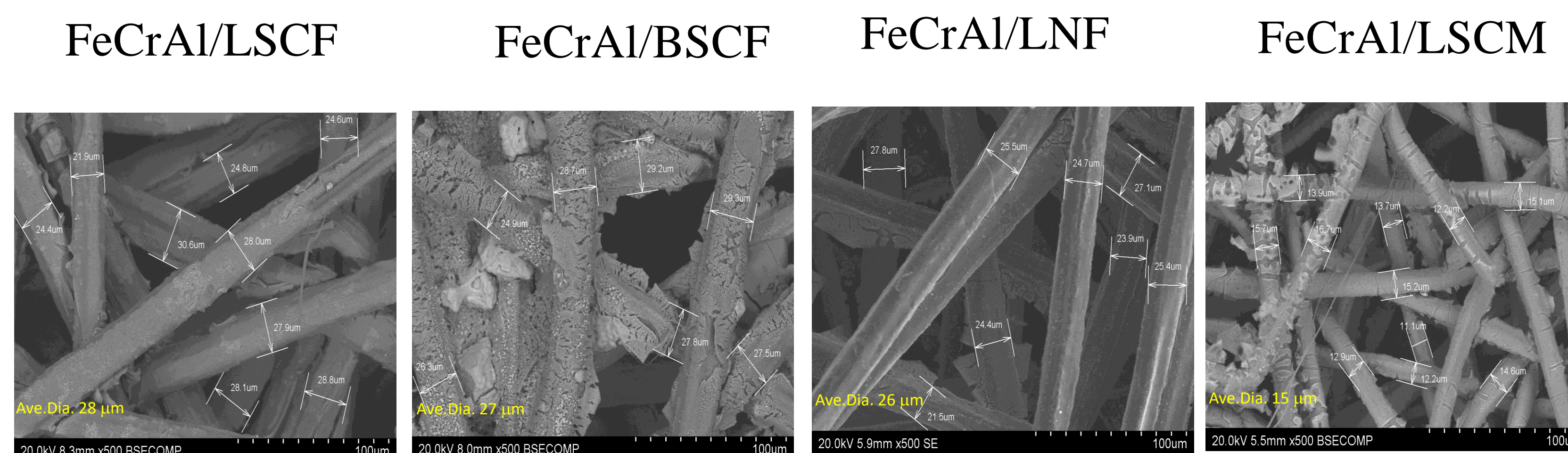
Fuel Cell Elements Concept



Objectives:

- Increase the lifetime of a cell by impregnating the metal fibres of our FeCrAl supports by soaking them into sol-gel solutions.
- The objective, which is highly original for the target application, is to coat the micrometric fibres of the support with a very thin layer of oxide compatible with FeCrAl alloy.
- This process aims to protect the FeCrAl support from oxidation at high temperature.

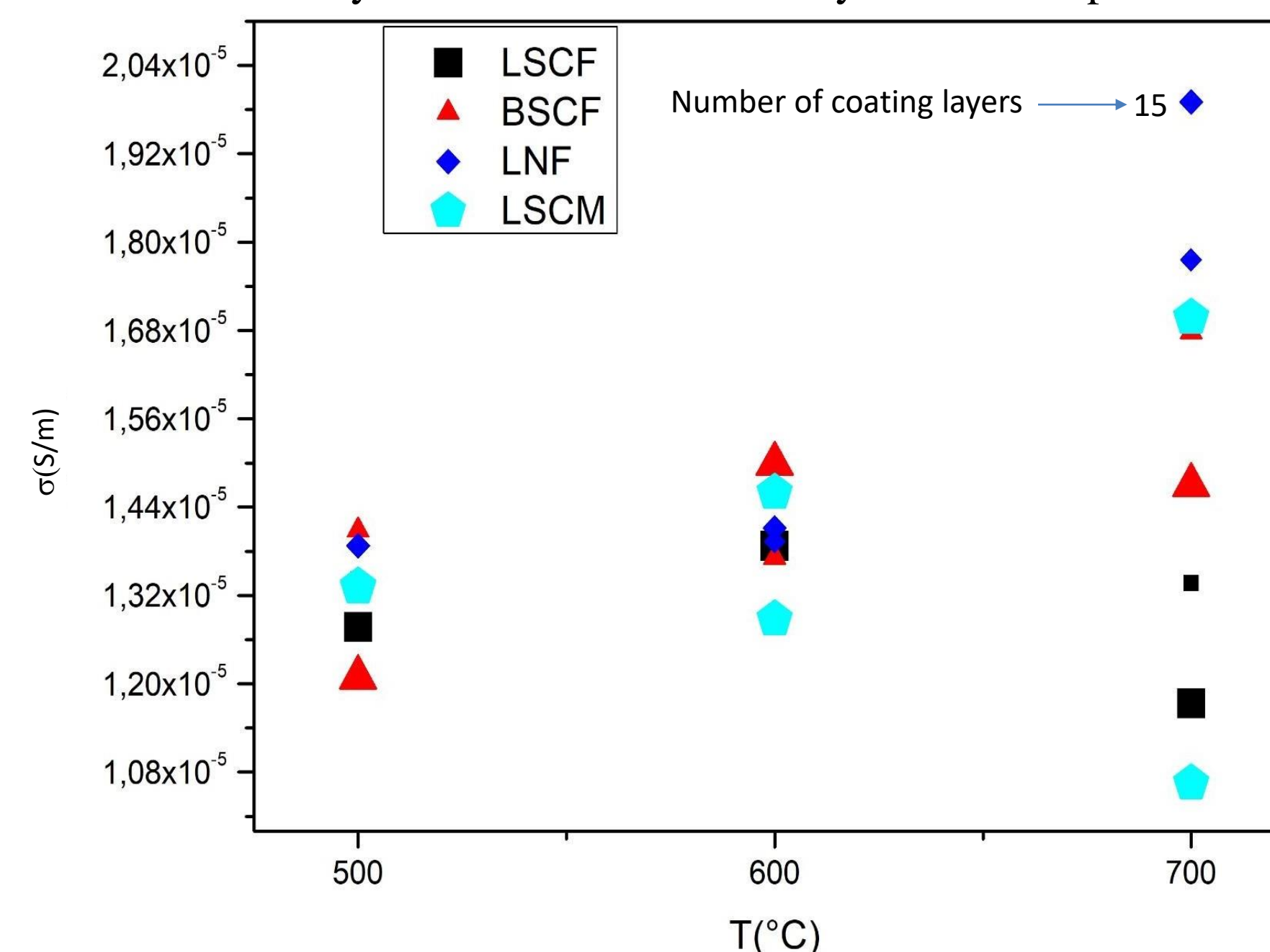
Morphological Characterization -SEM



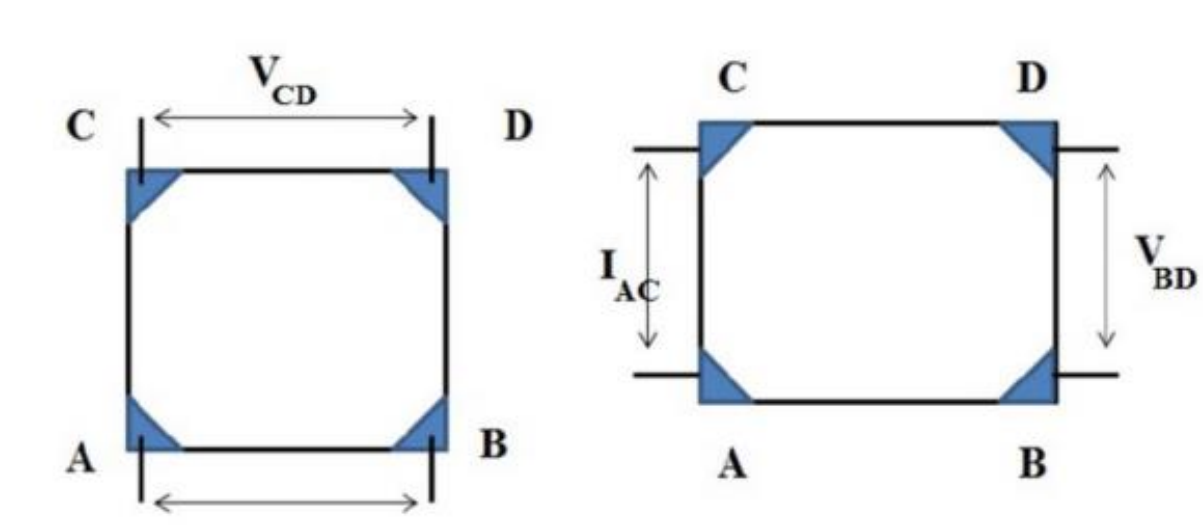
- The best homogen coating quality is observed on the FeCrAl substrate impregnated with LSF and LNF sol-gel solutions

Electrical Conductivity Measurement

- The conductivity measurement has been performed using four-point approach
- Conductivity values of 50 h thermally treated samples.



Van der Pauw method



- Resistivity of FeCrAl support before coating : $13 \cdot 10^{-3} \Omega \text{ mm}$

- Best results are obtained from metallic support FeCrAl impregnated with LSCF and LNF sol gel solutions.

Conclusion

The results show that the oxide-based coating layer exhibits good adhesion to the supports and improves the resistance to corrosion. In addition, the impregnated metal supports exhibit higher electric conductivity. This approach offers a promising solution for protection against corrosion of metallic support in MS-ITSOFC applications.

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