Densification of doped lanthanum gallate (LSGM) electrolytes using activated microwaves field

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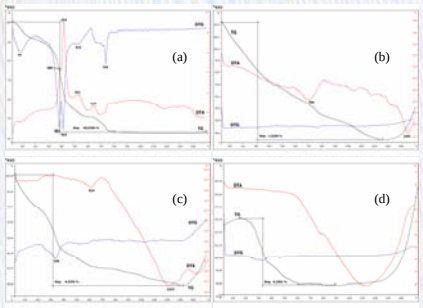
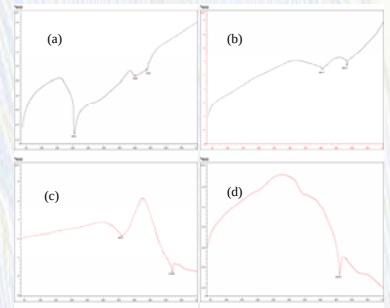
Aim

Sr^{2+} and Mg^{2+} simultaneous doped lanthanum gallate (LSGM) powders, prepared by a modified Pechini route, were dandified using an activated microwave technique at 2.45 GHz to develop a dense stable electrolyte layer for application in intermediate temperature- solid oxide fuel cells (IT-SOFC).



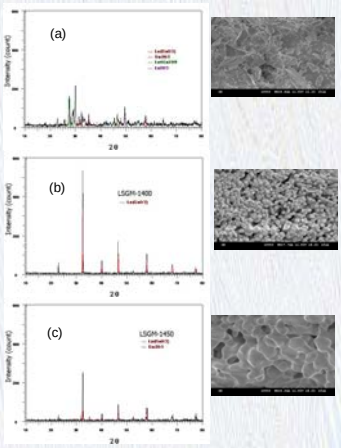
DTA/TG curves of precursors: a) 250^{0}C and b)900^{0}C/1h; microwave sintered at c) 1400^{0}C/10min and classic sintered in furnace d) 1450^{0}C/2h

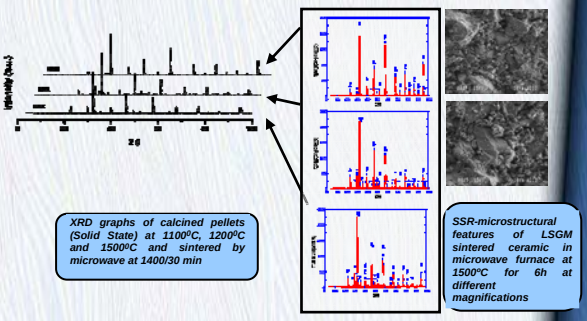


DSC curves of precursors: a) 250^{0}C and b)900^{0}C/1h; microwave sintered at c) 1400^{0}C/10min and classic sintered in furnace d) 1450^{0}C/2h

EXPERIMENTAL

All reagents used were of purity : $La(NO_3)_3x6H_2O$, $Ga(NO_3)_3xH_2O$; $Mg(NO_3)_2x6H_2O$, $Sr(NO_3)_2$, $C_6H_8O_7$ and PVA [–(CH2-CH-OH)-*n*] *n*=900
Strontia- and magnesia-doped lanthanum gallate corresponding to the formula $La_{0.8}Sr_{0.2}Ga_{0.83}Mg_{0.17}O_{2.815}$ was prepared through a Pechini route. Appropriate amounts of the salts were dissolved in distilled water separately and homogenized. To this solution, citric acid was added as a complexant. Polyvinylalcohol (PVA) was added to enhance gelation. The resultant solution was then slowly evaporated over a hot plate at 70ºC and 24 hours at 80 ºC in oven in order to form the gel. The gel so formed was dried in an heating mantle at 250ºC, which resulted in a fine precursor powder. The precursor was then heated for one hour al 900ºC. This powder (215 m2/g) was compacted into solid disks for further heat treatment by exposure to microwaves for 10 min using SiC as the microwave susceptor in a domestic modified microwave oven (2.45 GHz; 800 W).

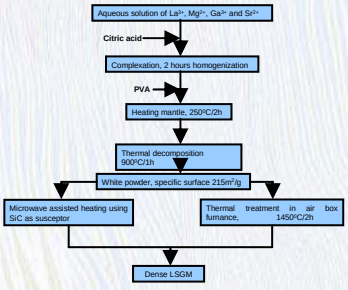




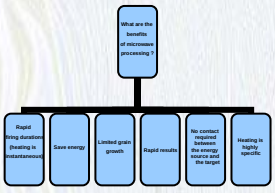
XRD graphs of calcined pellets (Solid State) at 1100^{0}C, 1200^{0}C and 1500^{0}C and sintered by microwave at 1400/30 min

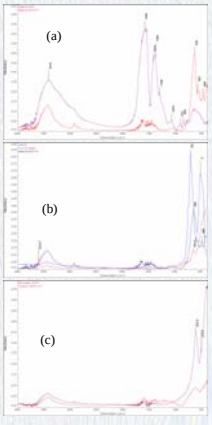
SSR-microstructural features of LSGM sintered ceramic in microwave furnace at 1500ºC for 6h at different magnifications

XRD patterns and corresponding SEM micrographs of a) precursor calcined at 900^{0}C/1h, b) sintered pellets at 1400^{0}C/10min activated microwave field, c)sintered pellets at 1450^{0}C/2h in classic furnace

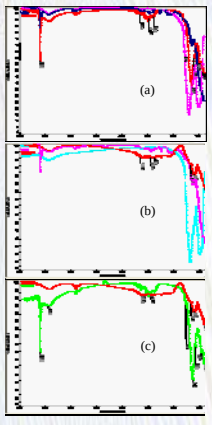


Flow chart of the synthesis procedure





IR spectra for: a) LSGM 250-900, b) LSGM 900^{0}C/1h and c) LSGM 1400 and 1450 microwave samples (PECHINI)



IR spectra for: a) LSGM 1100, b) LSGM 1500 and c) LSGM 1100 and 1500 microwave samples (Solid State)

Conclusion

- **Doped lanthanum gallate ($La_{0.8}Sr_{0.2}Ga0_{.83}Mg_{0.17}O_{2.815}$) can be prepared as a single-phase cubic perovskite by the Pechini method (polyvinylalcohol (PVA) as polyhydroxy alcohol)**
- **Fine, homogeneous and high density (>90% of the theoretical density) pellets of pure LS0.2GM0.17 were obtained after calcination at 1400^{0}C for a short period time in an activated microwave field.**
- **The XRD pattern shows that the main phase (LSMG) exist in the unsintered powders. With the increase of temperature, the amounts of secondary phases decreased remarkably. Due to the heat generation in situ, the process of sintering is activated with faster kinetics compared to a conventional sintering technique.**
- **The LSGM prepared through the modified Pechini method has higher quality than the solid-state route and is suitable for thick films preparation. The sintering temperature affects the average grain size severely, while the sintering time has little effect on the grain size.**
- **Further investigation on the mechanism and sintering process are in progress**

Stacked ceramic samples

Acknowledgement

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