Nanocrystalline $La_{0.8}Sr_{0.2}Mn_yFe_{1-y}O_{3-\delta}$ perovskites and their oxygen deficiency correlation with their oxygen permeation and CO oxidation properties

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Materials of the perovskite structure[1-5] have attracted much attention in various research field including catalysis, photovoltaics, magnetoresistance, fuel cells, thermal barrier coating, oxygen membranes etc mainly due to their tuneable properties by composition. However nano or microstructural control introduces further interesting properties[5-10] either perovskites are studied solely or in nanocomposites. Recently, manganates with mean size of crystallites lower than ≈100 nm were found attractive also in medical applications. Studies on the correlation of perovskites composition and properties with catalytic activities dates back to the 70s. However a growing interest still exists on their oxygen non stoichiometry as well as their nanostructure effect on the above research fields.

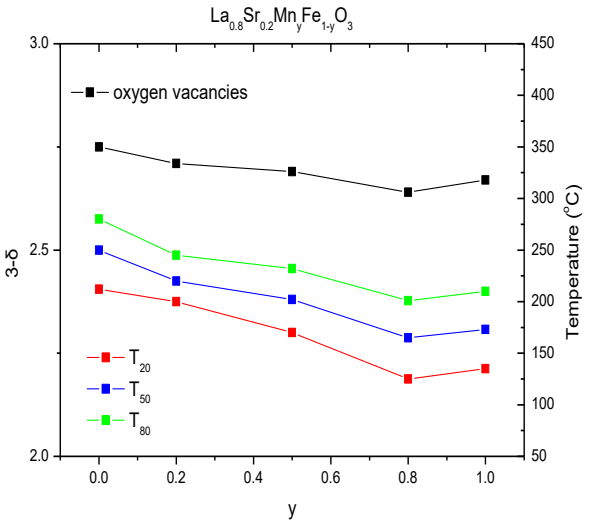

Fig.1. Correlation of catalytic behavior ($T_{20/50/80}$: temperature of 20%, 50% or 80% CO conversion) and oxygen vacancies with Mn content (y)

The present paper aims at the investigation of the interrelation between the composition, microstructural properties and the oxygen deficiency of $La_{0.8}Sr_{0.2}Mn_yFe_{1-y}O_{3-\delta}$ (y=0-1) type perovskites, influencing their properties as membranes or oxidation catalysts.

$La_{0.8}Sr_{0.2}Mn_yFe_{1-y}O_{3-\delta}$ (y=0-1) were prepared using a modified sol-gel assisted microwave method towards materials with high purity, dispersion and low crystal size. XRD-Rietveld, SEM, BET, TGA techniques and oxygen permeation measurements were used to characterize the samples. Their catalytic activity was studied in CO oxidation reaction in a continuous-flow fixed-bed tubular plug flow reactor, with a gas mixture of 1000ppm CO + 1% O_2 in He.

All materials prepared were found single phase pure perovskites with a nanocrystalline structure exhibiting nanocrystals of ~20 nm. Their nanocrystallinity was significantly enhanced by the preparation method used. Their oxygen non stoichiometry was measured and found composition related. The same trend was found on their oxygen permeation values and on their catalytic CO oxidation performance (**Fig.1**). The findings demonstrate a direct correlation between the intrinsic property of O_2 stoichiometry with both catalytic and oxygen permeation behavior of such perovskite materials. Such data indicate that materials such as perovskite studied that may activate and transport oxygen via their vacancies in membrane applications may act as efficient oxidation catalysts and vice versa.

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