Effect of A-site dopant on hydrogen $La_{1-x}M_xAl_{1-y}Mn_y$ (M=Na and Sr) perovskite oxides for thermochemical water splitting applications

Müzeyyen Özdemir[1] , Berke Pişkin[1]
Department of Energy, Muğla Sıtkı Koçman University,48000,Muğla,Turkey

The study focuses effect of A-site substitution on the structural properties of $La_xNa_{1-x}Al_yMn_{1-y}$-$La_xSr_{1-x}Al_yMn_{1-y}$ (x=0.2, 0.4, 0.6, 0.8, y=0.2, 0.4, 0.6, 0.8) (Na-Sr) perovskite oxides were synthesized by the Pechini method to observe the effect of structural properties on hydrogen production. Na was used as the A-site dopant, which was studied for the first time [1].
8 different compositions in the LNAMn, LSAMn oxide family evaluated by the water splitting test. Figure 1 shows that oxygen production capacities of given perovskite oxides.

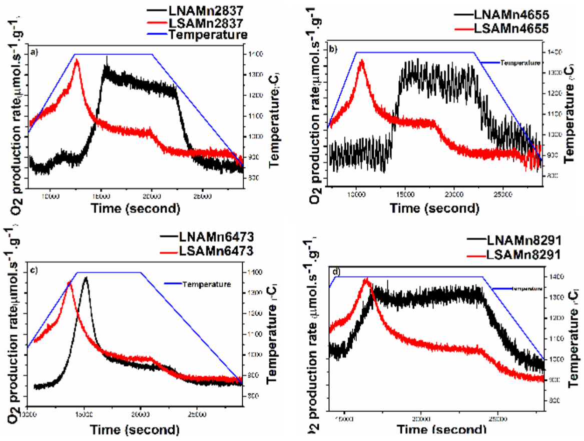


Figure 1. The O_2 production rate-time profiles a) LNAMn2837 and LSAMn2837 b) LNAMn4655 and LSAMn4655 c) LNAMn6473 and LSAMn6473 d) LNAMn8291 and LSAMn8291 perovskite oxides.

The areas under the curves are also the total O_2 gives the amount of formation. All the studies carried out O_2 formation were determined in the compositions, Table 1.

Table 1. O_2 production in LNAMn and LSAMn perovskite oxides.

Perovskite Oxide	First O_2 Temperature (°C)	O_2 Amount(µmol)
LNAMn2837	600	159
LNAMn4655	880	328
LNAMn6473	1100	340
LNAMn8291	900	374
LSAMn2837	1350	696
LSAMn4655	1330	642
LSAMn6473	1400	494
LSAMn8291	1400	641

According to these data, it was determined that more O_2 production was observed in the Sr-doped perovskites compared to Na-doped ones. than the Na ones. Similarly, the H_2 production capacities were determined at 800°C by the thermochemical water splitting test, Figure 2.

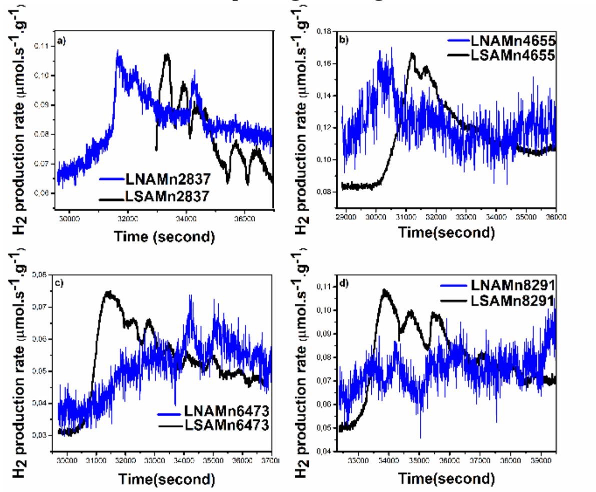


Figure 2. The H_2 production rate-time profiles a) LNAMn2837 and LSAMn2837 b) LNAMn4655 and LSAMn4655 c) LNAMn6473 and LSAMn6473 d) LNAMn8291 and LSAMn8291 perovskite oxides.

H_2 production was observed in all the compositions considered. All of the studies carried out H_2 formation was determined in the compositions, Table 2.

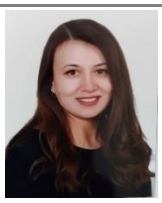
Table 2. Values obtained during H_2 formation from perovskite powders.

Perovskite Oxide	H_2 Amount(µmol)	H_2/O_2 (µmol/g)	H_2/O_2 (%)
LNAMn2837	54	0.33	67.92
LNAMn4655	30	0.09	18.29
LNAMn6473	26	0.07	15.29
LNAMn8291	29	0.07	15.51
LSAMn2837	84	0.12	24.14
LSAMn4655	254	0.39	79.13
LSAMn6473	164	0.33	66.40
LSAMn8291	218	0.34	68.02

Redox activities for the compositions were obtained as approximately 79%, 66%,68%, and 67% for LSAMn4655, LSAMn6473, LSAMn8291, and LNAMn2837, respectively. It has been observed that Sr^{2+} element, which is the A-site doping element, plays a dominant role on hydrogen production.

References

[1]Scheffe, Jonathan R., David Weibel, and Aldo Steinfeld. 2013. "Lanthanum-Strontium-Manganese Perovskites as Redox Materials for Solar Thermochemical Splitting of H2O and CO2." *Energy and Fuels* 27 (8): 4250–57. https://doi.org/10.1021/ef301923h.



Müzeyyen Özdemir is a graduated from Sakarya University, Faculty of Arts and Sciences, Department of Physics in 2016. She taught physics for 3 years. She graduated from Muğla Sıtkı Kocman University, Instutue os Science, Department of Energy in 2022.

Presentating author : Müzeyyen Özdemir, e-mail:muzeyyenozdemir@posta.mu.edu.tr