Development of High Entropy Perovskite Oxides for Thermochemical Water Splitting

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Environmental pollution caused by fossil fuels is becoming more and more important to us day by day. Therefore, renewable energy sources and environmentally friendly energy production methods are gaining more and more importance day by day in order to reduce the problems that arise as a result of climate change(Sharma et al., 2021). One of the prominent energy sources in this regard is Hydrogen energy. Since hydrogen gas is a clean energy source that does not contain carbon, it is considered one of the most suitable sources for renewable energy.

Hydrogen is a promising energy source because it is abundant in nature. Hydrogen can be obtained in many ways. One of these methods is the Thermochemical water separation method(Osman et al., 2022). This method uses concentrated solar energy to carry out pure redox reactions, and hydrogen can be produced without the need for any purification, that is, it does not require catalysis to perform chemical reactions.(PİŞKİN, 2021)Perovskite oxides come to the fore due to their superior structural stability. It provides many advantages with its unique compositions, microstructures and adjustable properties. They are active substances that can be used in TWS reactions, thus positively affecting the hydrogen production efficiency.

In this context, $La_{0.7}Sr_{0.3}Cr_{0.2}Mn_{0.2}Fe_{0.2}Ni_{0.2}X_{0.2}O_3$ (LSCMFNX) (X=V,Ti,Co)based perovskite oxides were studied in this study. LSCMFNX powder was synthesized by Sol-gel-based Pechini method. As starting chemicals, nitrates of all of the considered cations were used: La(NO3)3·6H2O, Sr(NO3)2, Co(NO3)2·6H2O, Fe(NO3)3·9H2O, Mn(NO3)2·4H2O and Ni(NO3)2·6H2O, NH4VO3, $Co(NO_3)_2 \cdot 6H_2O$, $Ti(NO_3)_4$. Primarily, the stoichiometric amount of the metal nitrate precursors were dissolved in distilled water, then citric acid and ethylene glycol were added into the solution. The molar ratio of all the cations, citric acid, and ethylene glycol in the mixture was 1:2:4. The solution was heated up to 70°C with continuous stirring by the help of the magnetic stirrer to drive the esterification reactions. The resulting gel was dried at 250°C for 2 hours to remove residual organics and nitrates. The dried gel was calcined at 700°C, 850°C,1000°C, 1150°C and 1300°C for 6 hour. The resulted structures were characterized with respect to their crystal structure and particle size and candidate materials are selected for using TWS redox reactions

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