# Synthesis, characterization, and electrocatalytic properties of $SmMn_{0,5}M_{0,5}O_3$ (M = Cr, Fe, Co, Ni) perovskite materials

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In recent decades, significant research has focused on perovskite-type compounds ($ABX_3$), making them one of the most thoroughly studied material classes. The growing scientific interest in these compounds is due to their flexible composition and structure, which results in a wide variety of remarkable and unique properties. Of particular interest are oxide perovskites with manganese at the B-site and certain lanthanides at the A-site, as they offer both scientifically and practically intriguing properties. This study focuses on the synthesis and characterization of novel complex perovskites with the formula $SmMn_{0,5}M_{0,5}O_3$, where M can be Cr, Fe, Co, or Ni. The assumption that compounds with this composition would have a perovskite structure was confirmed by calculating the tolerance factor. These compounds were synthesized by the Solution combustion method using glycine as fuel. The perovskites obtained were characterized by X-ray powder diffraction (XRPD), scanning electron microscopy (SEM) with energy dispersive X-ray spectroscopy (EDX), infrared spectroscopy (IR) and cyclic voltammetry. The XRPD patterns confirmed the compounds purity and showed that all the materials in the series share the same structure. SEM images revealed a porous morphology characteristic of perovskites obtained by the solution-combustion method, and EDX analysis verified the 2:1:1 ratio of Sm:Mn:M. IR spectroscopy further examined the perovskites, with spectra in the far-IR region displaying characteristic bands from the stretching and bending vibrations of Mn/M–O and Sm–O bonds. The shifts in these bands due to different M cations matched theoretical predictions. Cyclic voltammetry, conducted using paraffin-impregnated graphite electrodes (PIGE) modified with the perovskites, confirmed their electrocatalytic activity, specifically for the oxidation of $OH^-$ ions and $H_2O_2$ in phosphate buffer solution.