Electronic Supplementary Material (ESI) for RSC Advances.

Fabrication of Spinel Ferrite based Alkaline Anion Exchange Membrane Water Electrolysers for Hydrogen Production

1. Material Synthesis & Characterization:

1.1 Manganese ferrite synthesis: Manganese ferrite and cerium substituted manganese ferrites were synthesized by a combustion method. Aliquot amounts of analytical grade metal nitrates Mn (NO3)2.6H2O and Fe (NO3)2.9H2O were mixed with hexamine and dissolved in deionized water to obtain a precursor solution. The solution was preconcentrated in a quartz crucible until the free water evaporated, after which spontaneous combustion of the dried powder occurred. This resulted in the formation of black porous ash in the container. This ash was then sintered at 1100ºC for 24 hours in an electrical furnace. The catalyst was milled for 8 hours in a Retsch PM 100 ball mill at room temperature at 600 rpm. For milling experiments, the ball-to-powder weight ratio was taken as 40:1.

1.2 Physical Characterization:

Catalyst crystallinity and structure examined by a powder X-ray diffractometer (Model D8 Advance, Bucker) with a Cu- Kα1 X-ray radiation (λ = 0.15406 nm) source, operating at 40 kV and 30 mA. Catalyst morphology and surface composition investigated using a VEGA3 TESCAN Scanning Electron Microscope, with Energy Dispersive X-ray Spectroscopy (SEM/EDS). Atomic absorption spectroscopy (AAS) analysis were carried out on an Atomic Absorption Spectrophometer (Varian Model SPECTRAA 220) using the Acetylene-Air flame.X-ray photoelectron spectroscopy (XPS) was carried out on MULTILAB 2000 Base system with X-ray, Auger and ISS attachments (Thermo scientific) with Twin Anode Mg/Al (300/400 W) X-ray Source.

1.3 Electrochemical measurements:

Electrochemical experiments were conducted at room temperature using a Biologic Science Instrument VMP3 multichannel potentiostat. In the three-electrode system, a Pt wire was employed as the counter electrode, and all potentials were measured in comparison to a 1 M KOH Hg/HgO reference electrode that was housed in a custom glass Luggin capillary. The potential of the 1 M KOH Hg/HgO reference electrode was 0.929 V. KOH solutions (0.1M and 1.0M) were used as electrolytes. The Cyclic voltammograms of catalysts were recorded in 1M KOH solution with a scan rate of 10mV/s. The scan rate for all other electrochemical measurement was 1 mV/s .Current densities were calculated using geometric surface areas.

Electrochemical impedance spectroscopy (EIS) measurements were conducted in the frequency range 1 MHz to 10 Hz, 1.6 V versus RHE, with an AC voltage amplitude of 10 mV.