**Supporting Information**

Synthesis, characterization, and selective benzyl alcohol aerobic oxidation over Ni-loaded BaFeO3 mesoporous catalyst

Naushad Ahmada\*, Manawwer Alama, Syed Farooq Adila\*, Anees A. Ansarib, Mohamed E. Assala, Shahid M. Ramayc, Mukhtar Ahmedd, M. Mujahid Alame, Mohammed Rafiq H. Siddiquia

*aDepartment of Chemistry, King Saud University, Riyadh 11451, Kingdom of Saudi Arabia*

*bKing Abdullah Institute for Nanotechnology, King Saud University, Riyadh 11451, Kingdom of Saudi Arabia*

*cDepartment of Physics, King Saud University, Riyadh 11451, Kingdom of Saudi Arabia*

*dDepartment of Zoology, King Saud University, Riyadh 11451, Kingdom of Saudi Arabia*

*eDepartment of Chemistry, College of Science, King Khalid University, Abha 62529, Saudi Arabia*

\*Corresponding author

E-mail addresses: [naushaddrnaima@gmail.com](mailto:naushaddrnaima@gmail.com), [anaushad@ksu.edu.sa](mailto:anaushad@ksu.edu.sa) (Dr. Naushad Ahmad), [sfadil@ksu.edu.sa](mailto:sfadil@ksu.edu.sa) (Dr. Syed Farooq Adil)

*2.2. Catalyst Characterization*

Powder XRD of the pre-calcined samples was performed on a Rigaku Ultima IV diffractometer (Japan). A ceramic tube with Cu *Kα* radiation (λ = 1.54184 Å) was set up for operation at a 40 kV voltage and 40 mA current. XRD patterns were collected in the 2θ range of 10-80° in the continuous mode, with a scan speed of 0.2° min-1. The obtained data were refined using the HighScore Plus software for structure determination. The metal compositions were determined using ICP-optical emission spectroscopy (OES) (Thermo iCAP 6300). Approximately 100 mg of each ground sample was dissolved in 65% HNO3 solution and diluted. Each sample was analyzed in triplicate using a certified reference material. FT-IR spectra were recorded over the 4000-400 cm−1 range on a Bruker Tensor 27 FT-IR instrument equipped with a quartz sample holder using KBr pellets. UV–vis diffuse reflection spectroscopy (UV–Vis DRS) was conducted on a Hitachi U-3410 spectrophotometer in the wavelength range of 200-800 nm, using optical-grade BaSO4 powder as a reference. The thermal decompositions of the perovskite precursors were performed via simultaneous thermogravimetric analysis (TG-DTG), using a Mettler Toledo TGA/DSC 1 STARe thermal analyzer (Switzerland), between 50-900 °C with heating rate of 20 °C/ min under N2 atmosphere with (20 mL/min) flow rate. The TEM images of the samples were recorded on a JEOL-2010 microscope with an accelerating voltage of 80 kV. The SEM measurements were achieved on a JEOL JSM-6380 LA (Japan) microscopy operated at 30 kV in the back-scattered electron detector and secondary electron detector modes.

The BET surface area (*S*BET), pore volume (*V*p), and pore size distribution (PSD) were measured using a three-port Micromeritics TriStar II 3020 (V1.03) surface area and porosity analyzer by adsorbing N2 gas at its liquefaction temperature (-196 °C). Prior to the N2 adsorption–desorption process, the samples were degassed at 300 °C for 3 h to remove the moisture and other adsorbed gases from the surfaces. For each analysis, about 0.5 g of the sample was used. The specific surface area was calculated using the BET equation over a relative pressure range (P/Po) of 0.09 to 0.3 with multiple-point (five points) measurements. The PSD was calculated from the desorption branch of the corresponding nitrogen adsorption–desorption isotherm by applying the Barrett–Joyner–Halenda (BJH) method. The pore volume was calculated from the uptake at a relative pressure of 0.99 cm3.g−1.

Temperature-programmed reduction (H2-TPR), oxidation (O2-TPO), and desorption (CO2-TPD) were recorded on a chemisorption apparatus (Micromeritics AutoChem II-2920) equipped with a thermal conductivity detector. Briefly, about 50 mg of the sample was loaded in a U-shaped quartz tube (6 mm ID). The sample was packed into the tube using quartz wool plugs and a thermocouple was inserted to measure the bed temperature. The sample was initially flushed with Ar at 300 °C for 60 min to remove adsorbed water, and then cooled to room temperature. H2-TPR was performed using a mixture of 10 % H2/Ar at a flow rate of 20 mL.min−1. The temperature was ramped from room temperature to 800 °C at a rate of 10 °C.min−1. The water formed during the reduction was trapped using a cold trap. After cooling the reduction sample to room temperature, it was exposed to 10 % O2/He for oxidation (O2-TPO) at the same operating condition. The basicity of the catalysts was determined using CO2-TPD, which was carried out at 50 °C for 30 min using a 10 % CO2/He mixture gas at a flow rate of 25 mL.min−1. Finally, the samples were heated to 700 °C at a rate of 10 °C.min−1 under He with a flow rate of 25 mL.min−1.