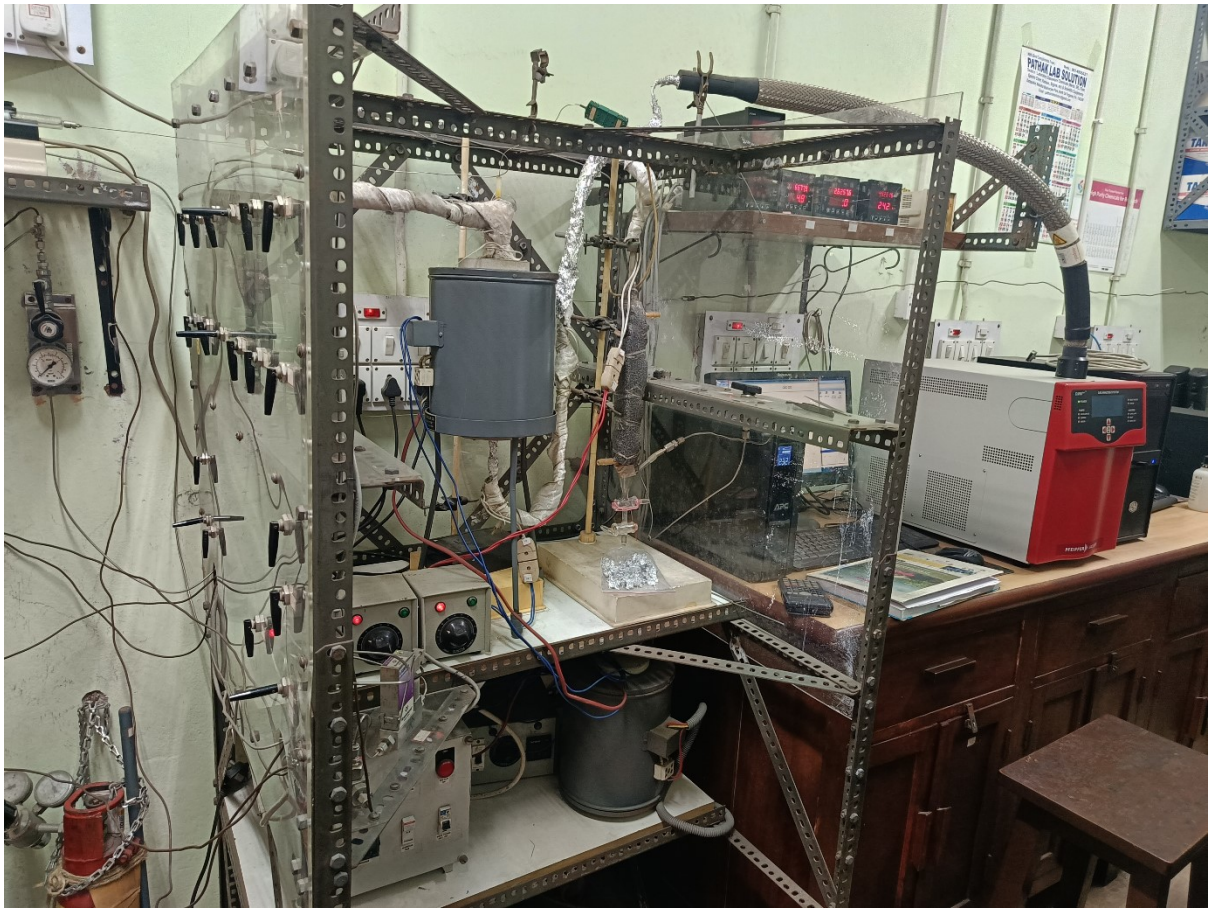
Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supplementary Information

High activity in dry reforming of methane by thermally switchable double perovskite and in-situ generated molecular level nanocomposite

Akbar Hossain[1], Monotosh Bhattacharjee[1], Kalyan Ghorai[1], Jordi Llorca[2], M. Vasundhara[3], Sounak Roy[4], Parthasarathi Bera[5], Md. Motin Seikh[6],* and Arup Gayen[1],*



Scheme S1: Photograph of the fabricated reaction set up used to test DRM activity.

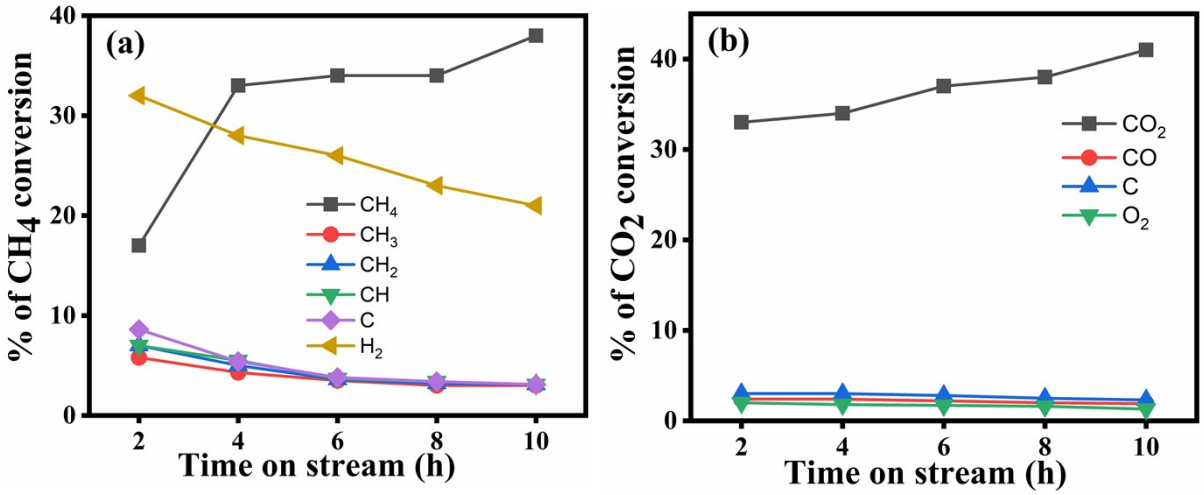


Fig. S1: Methane and carbon dioxide conversions owing to (a) CH_4 cracking and (b) CO_2 cracking at GHSV of 30000 h^{-1} at 800 °C using He as carrier.

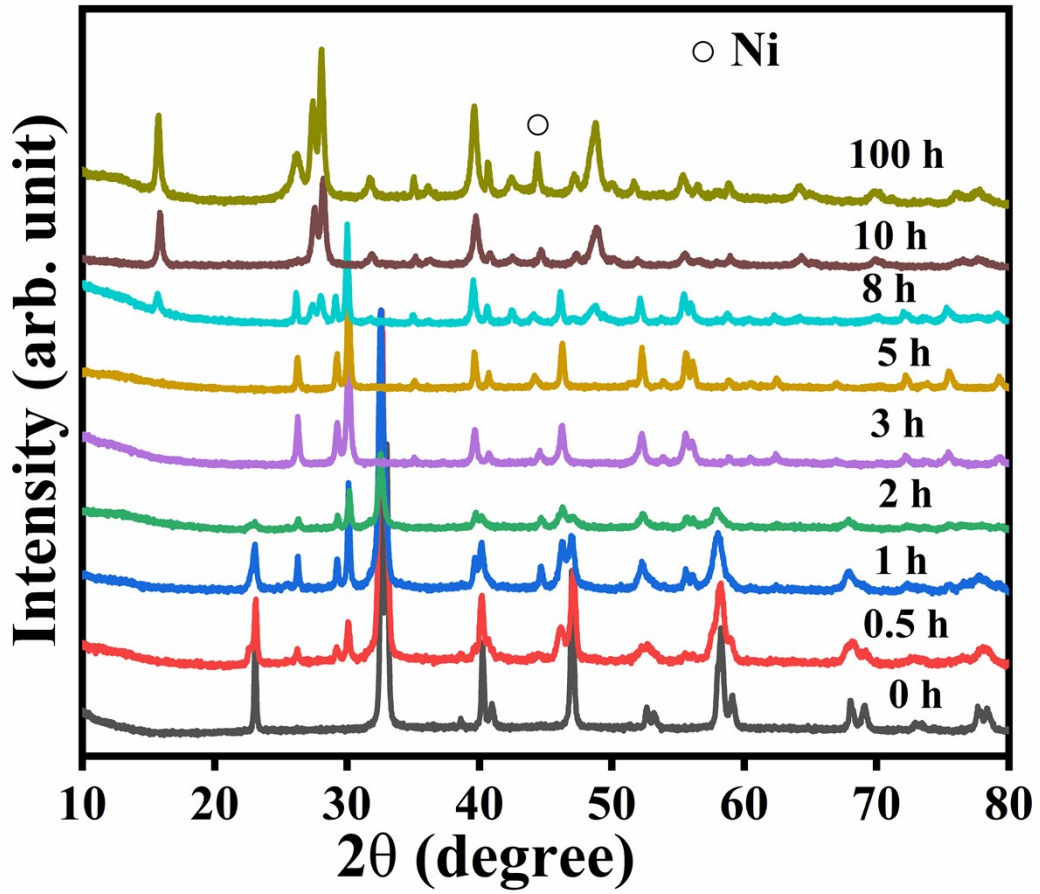


Fig. S2: Powder XRD patterns of LNMnO at various time intervals of DRM reaction. At any stipulated time, the reaction was stopped and then cooled in He flow to ~100 °C. The catalyst mesh was ground to powder and subsequently analysed for bulk phase analyses.

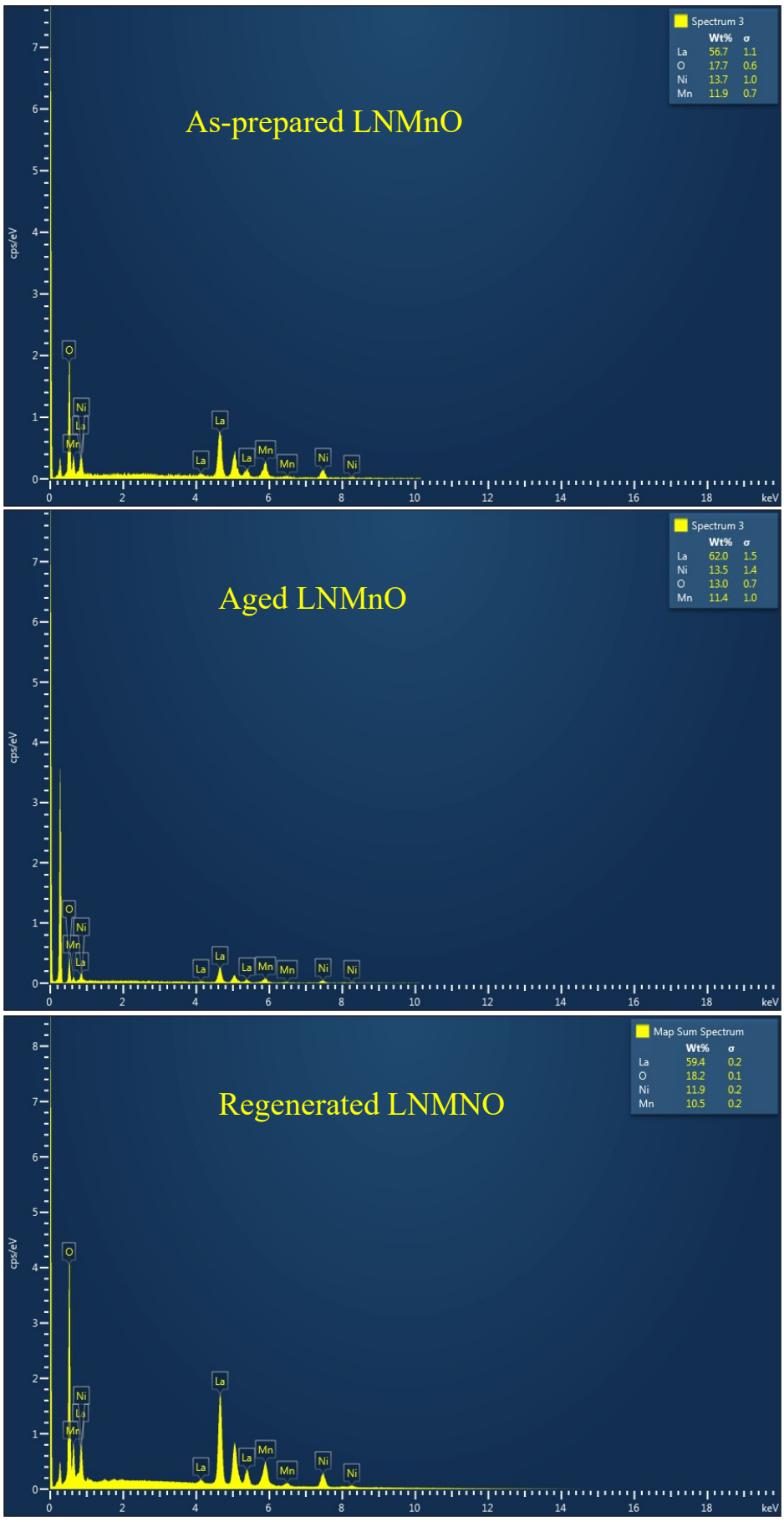


Fig. S3: EDX spectra of (a) fresh LNMnO, (b) aged LNMnO, and (**c)** regenerated LNMnO.

Sol-gel method of preparing La_2O_3, MnO, and NiO oxides

The individual oxides were prepared using the corresponding metal nitrates, namely $La(NO_3)_3.6H_2O$, $Mn(NO_3)_3.4H_2O$, and $Ni(NO_3)_2.6H_2O$ with citric acid as the fuel as elaborated in the main manuscript. The only change is associated with the calcination temperature and duration. The resulting fluffy mass was ground thoroughly to the powder form and subsequently calcined at 600 °C for 4 h, at 500 °C for 4 h, and at 500 °C for 3 h for the formation of La_2O_3, MnO and NiO, respectively.

Preparation of metallic Ni

Nickel nitrate and citric acid (in 1:4 molar ratio) were at first taken in a beaker with ~50 mL of Millipore water. The resulting mixture was vigorously stirred for a whole night to create a uniform solution, and then it was heated to 80–100 °C to evaporate water, creating the metal-citrate gel. After the evaporation was finished, the xerogel began to burn beyond 150 °C into the desired material.

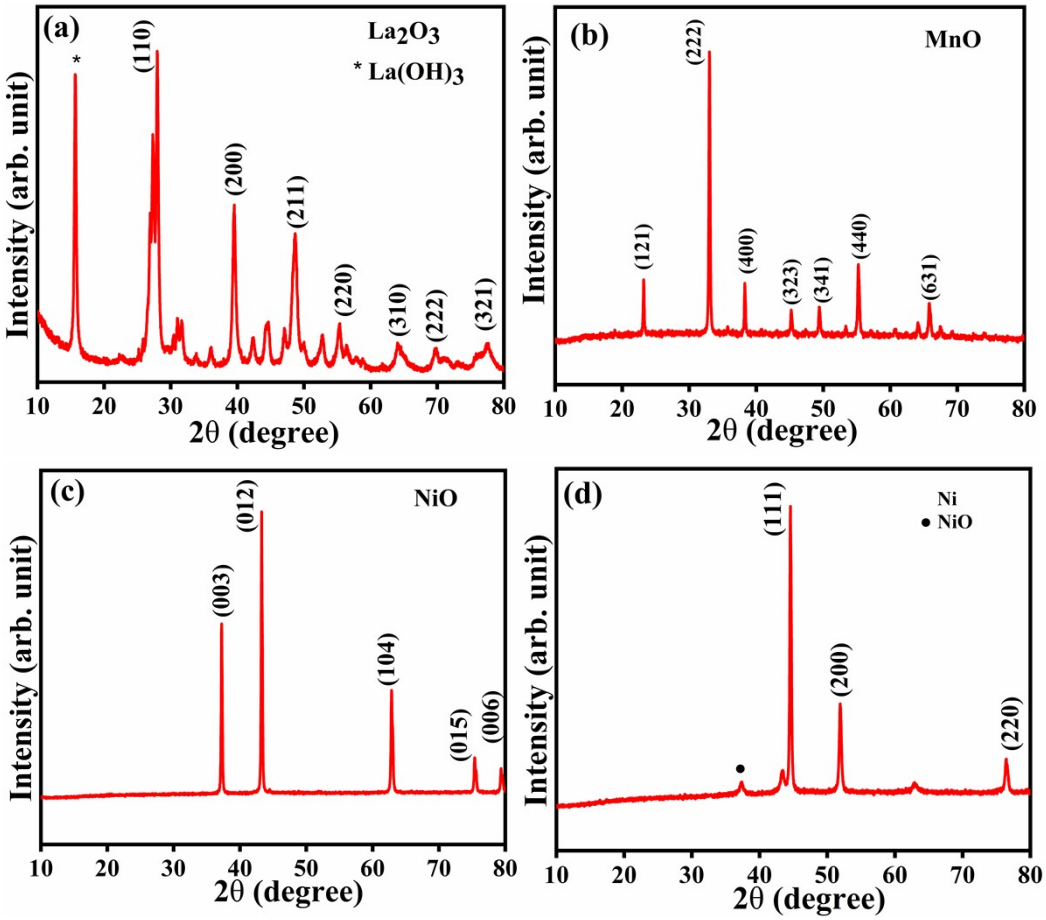


Fig. S4: Powder XRD patterns of (a) La_2O_3, (b) MnO, (c) NiO, and (d) metallic nickel.