Supporting Information for

Collateral Hydrogenation over Proton-Conducting Ni/$BaZr_{0.85}Y_{0.15}O_{3-\delta}$ Catalysts for Promoting CO_2 Methanation

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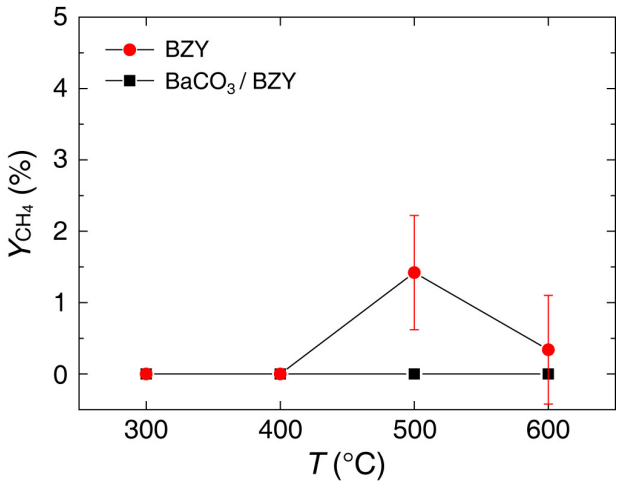

Fig. S1 CO_2 methanation performances of BZY and BZY-supported $BaCO_3$. All tested powders did not yield CH_4 gas at 400 °C.

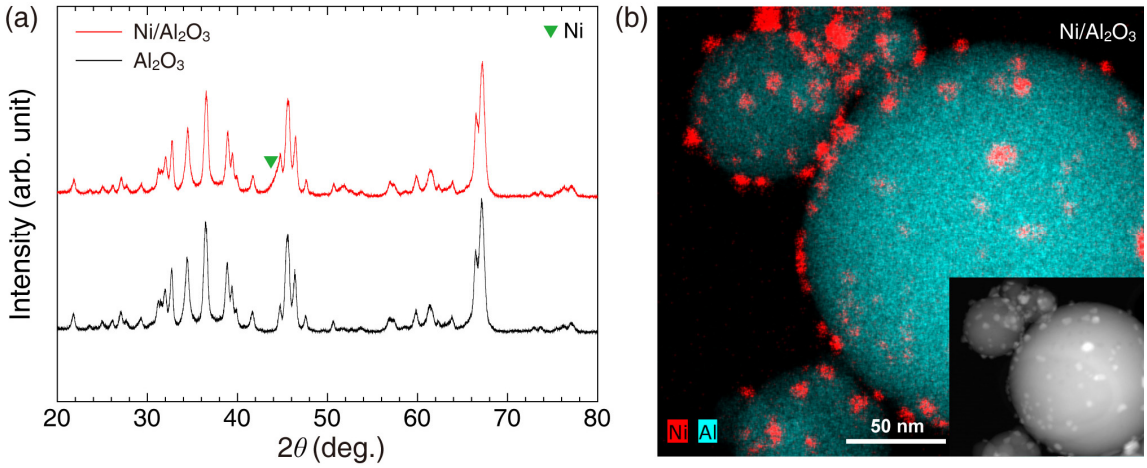

Fig. S2 XRD patterns and TEM images of Al_2O_3-containing powders. (a) XRD patterns of the Al_2O_3 support and the Ni/Al_2O_3 catalyst reduced at 600 °C for 2 h. (b) TEM image and EDS analysis result of the reduced Ni/Al_2O_3 catalyst, with Ni and Al elements denoted by red and cyan colors, respectively. Although the Al_2O_3 support exhibited a complex XRD spectrum, peaks of metallic Ni could be discerned at 44.5 and 51.8°. In addition, the reduced Ni catalysts featured an average particle diameter of 8.80 nm (standard deviation = 3.10 nm), while the spherical particles of the Al_2O_3 support had a diameter of ~50 nm.

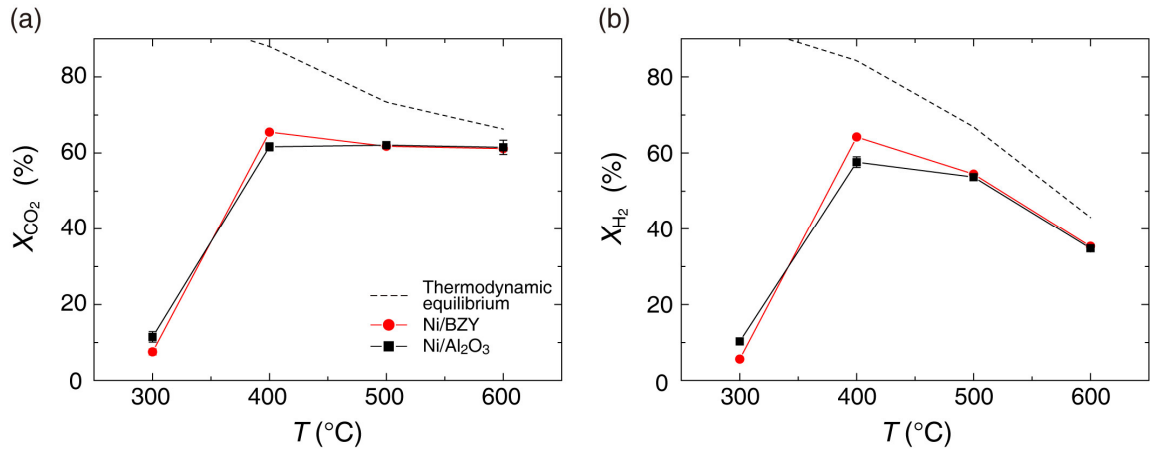

Fig. S3 Temperature-dependent (a) X_{CO_2} and (b) X_{H_2} values of Ni/BZY and Ni/Al_2O_3. The dashed line represents the thermodynamic equilibrium performance of each conversion under the chosen experimental conditions (H_2/CO_2 = 4.0).

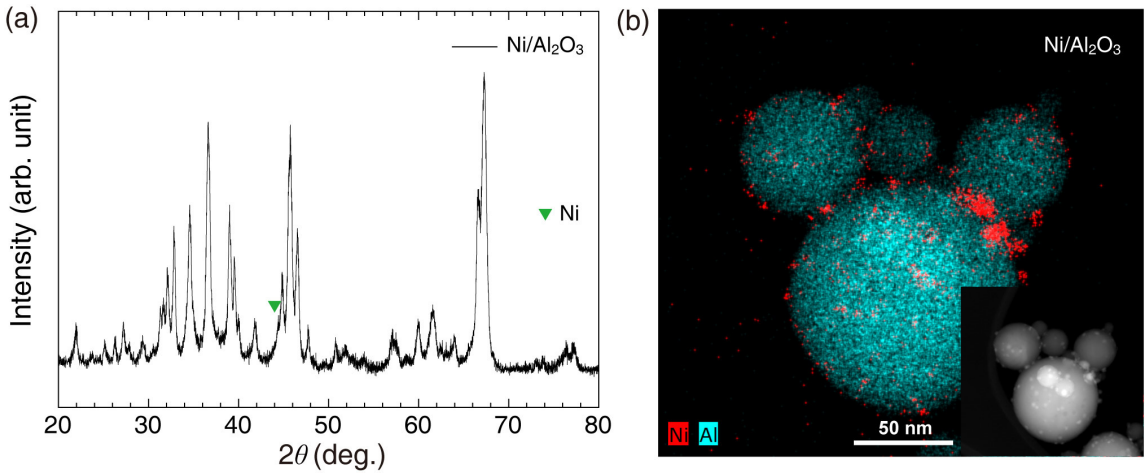

Fig. S4 XRD pattern (a) and TEM-EDS images (b) of Ni/Al_2O_3 subjected to 150 h CO_2 methanation at 400 °C. The average particle diameter of Ni on the Al_2O_3 support equaled ~9.06 nm (standard deviation = 3.50 nm).

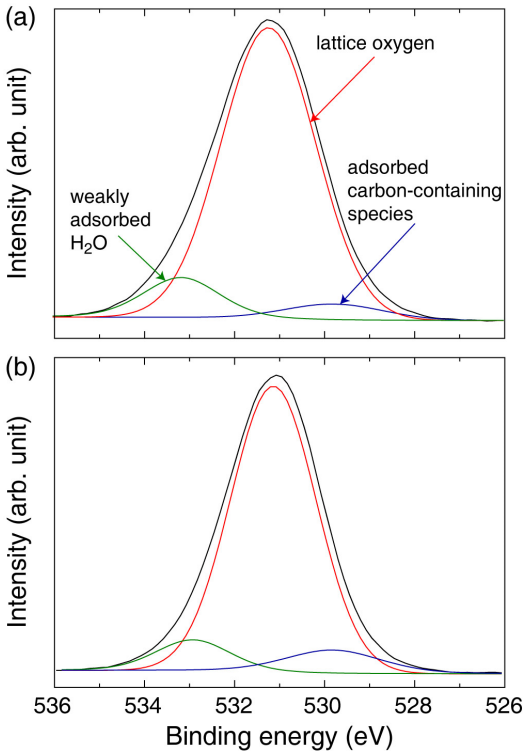

Fig. S5 O 1*s* core level XPS spectra of Ni/Al_2O_3 (a) before and (b) after CO_2 methanation. Red, green, and blue lines correspond to lattice oxygen, weakly adsorbed H_2O, and adsorbed carbon-containing species, respectively. The main peak centered at ~531 eV was assigned to the lattice oxygen of Al_2O_3.