

## Supporting Information

Kinetic advantages of microwave activation in dry reforming of methane –  
Insights gained by SSITKA

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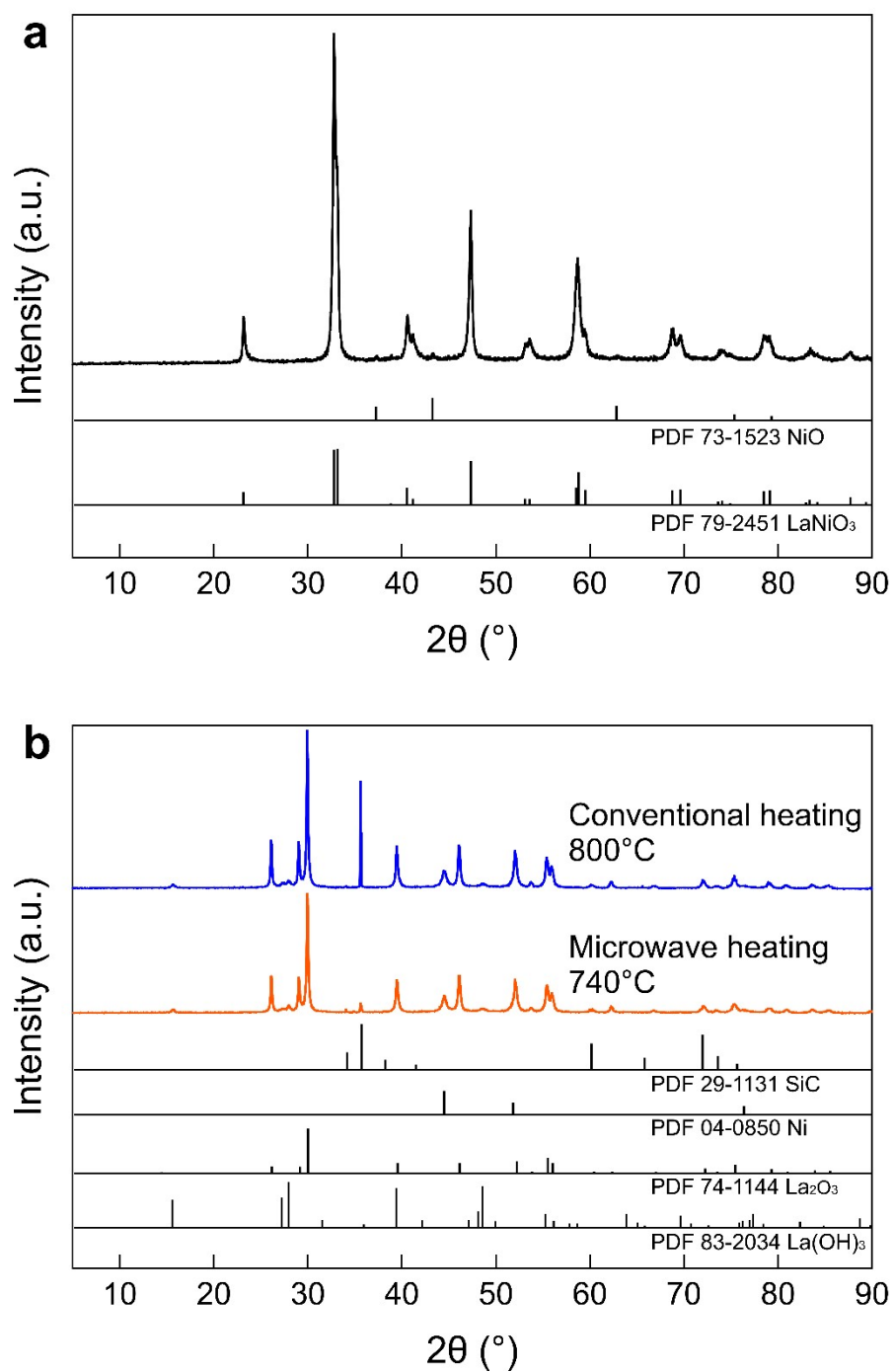


Figure S1. (a) XRD patterns of the as-prepared catalyst and (b) the catalysts after  $\text{H}_2$  reduction under conventional heating and microwave heating.

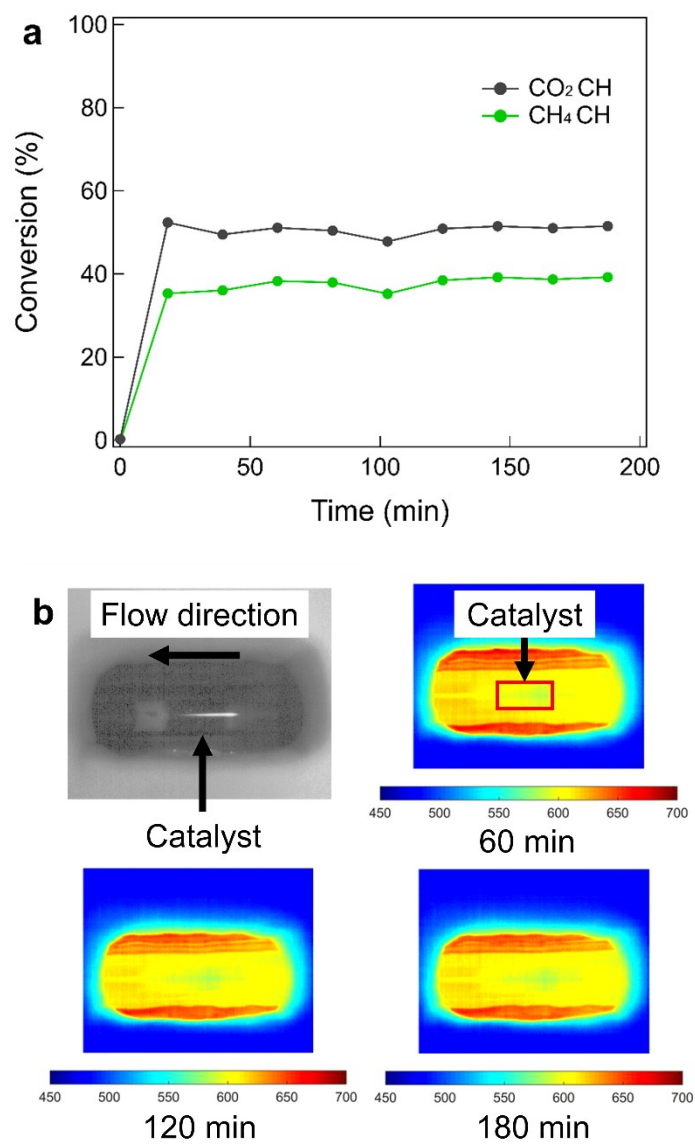


Figure S2. (a) Catalytic activity of DRM reaction under conventional heating (CH) at 600 °C and (b) temperature distribution of catalyst bed during the reaction.

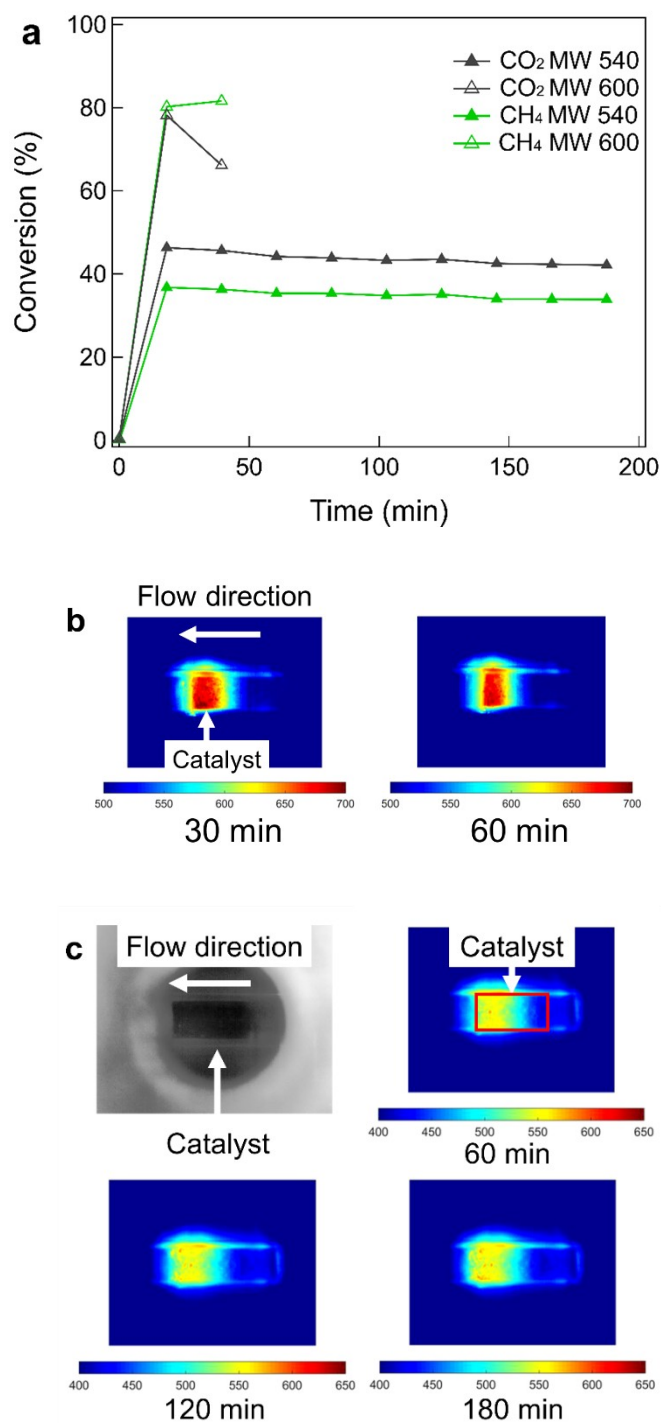


Figure S3. (a) Catalytic activities of DRM reaction under conventional heating at 600 °C and 540 °C under microwave heating and temperature distribution of catalyst bed during the reaction at (c) 600 °C and (c) 540 °C.

**Note:** The conversion data under microwave at 600 °C is missing from the second plot because the experiment was stopped around 60 min due to reactor clogging by carbon deposition.

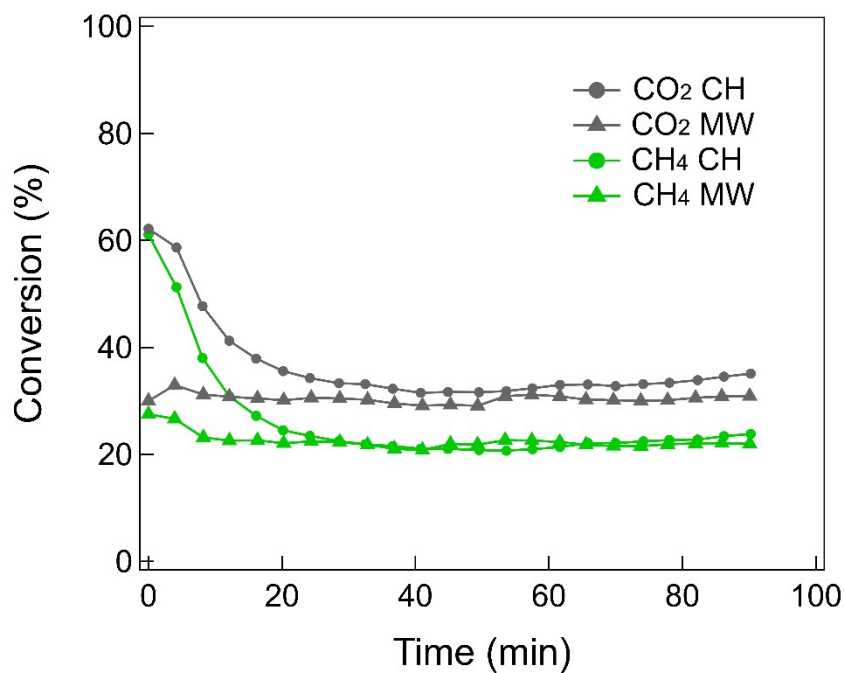


Figure S4. Catalytic activity during SSITKA under conventional heating (CH) at 600 °C and microwave heating (MW) at 490 °C under the condition of  $\text{CH}_4:\text{CO}_2 = 1:1$ .

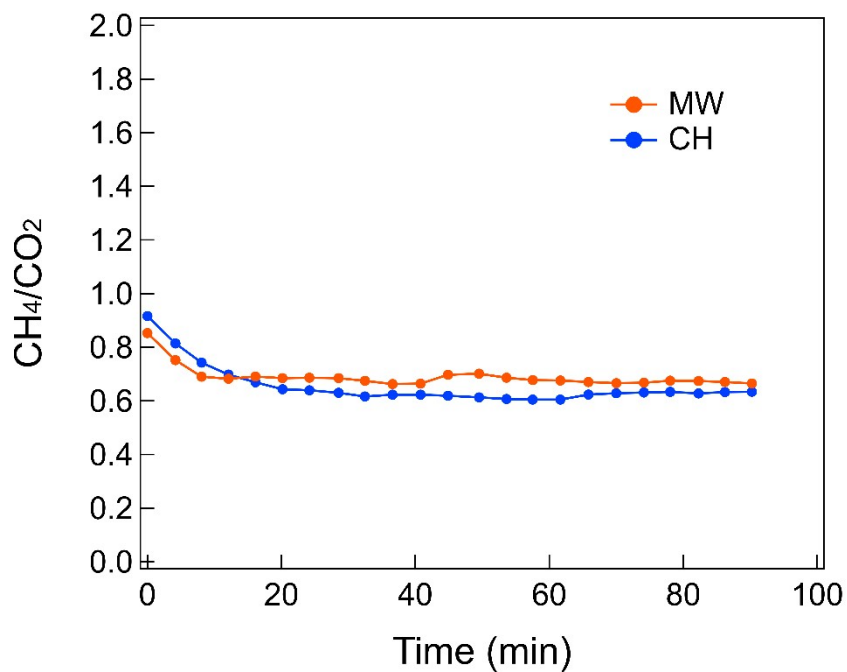


Figure S5. Ratio of converted  $\text{CH}_4/\text{CO}_2$  during SSITKA under conventional heating (CH) and microwave heating (MW) under the condition of  $\text{CH}_4:\text{CO}_2 = 1:1$ .

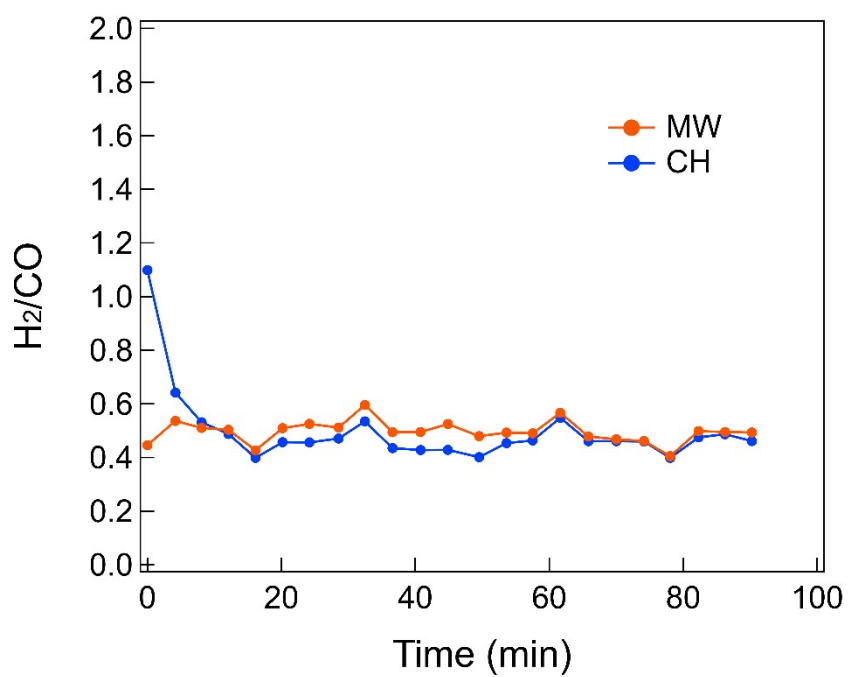


Figure S6. Ratio of produced H<sub>2</sub>/CO during SSITKA under conventional heating (CH) and microwave heating (MW) under the condition of CH<sub>4</sub>:CO<sub>2</sub> = 1:1.

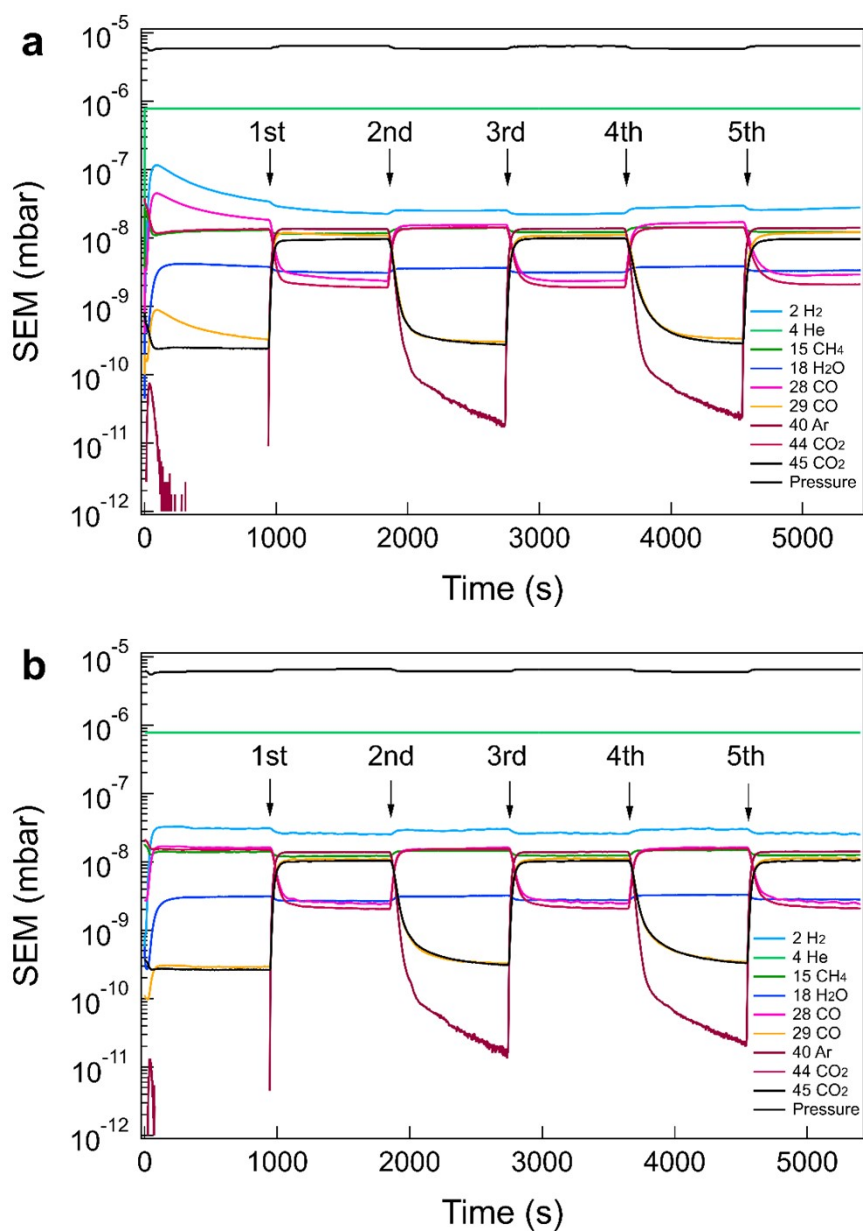


Figure S7. MS signal responses during SSITKA under (a) conventional heating at 600 °C and (b) microwave heating at 490 °C. The reactant switching between <sup>12</sup>CO<sub>2</sub> and <sup>13</sup>CO<sub>2</sub> was repeated five times under the condition of CH<sub>4</sub>:CO<sub>2</sub> = 1:1.

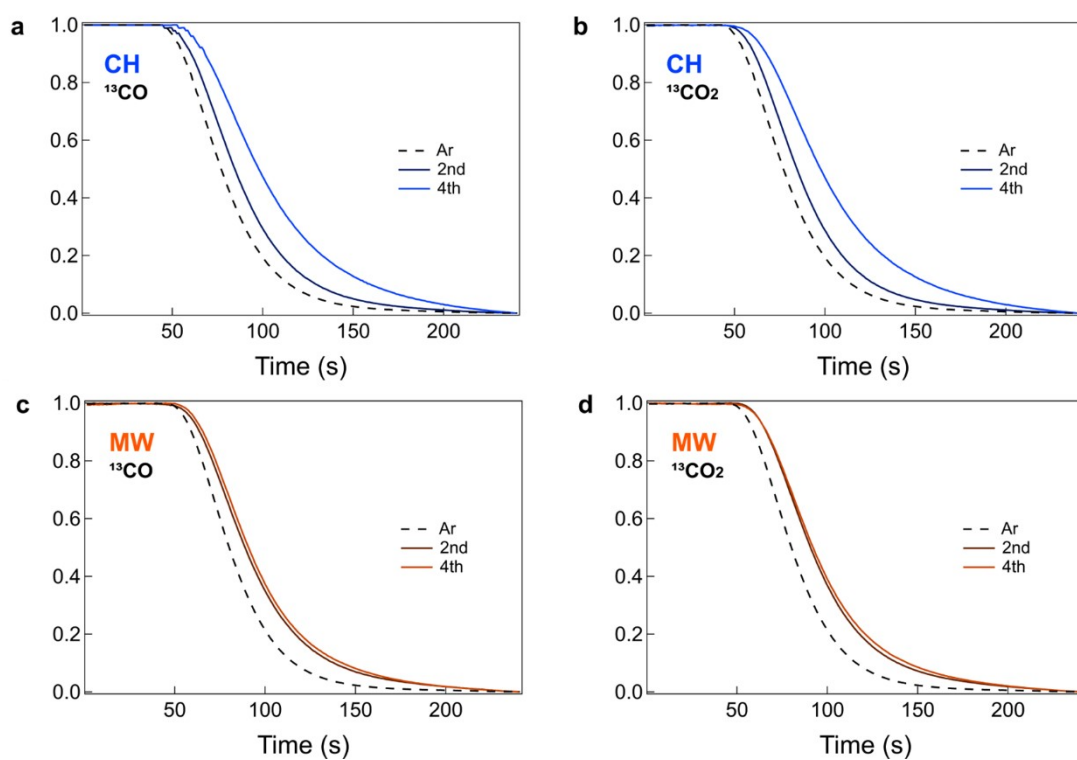


Figure S8. Normalized and overlaid 2<sup>nd</sup> and 4<sup>th</sup> switches of MS signals under the condition of  $\text{CH}_4:\text{CO}_2 = 1:1$ . (a)  $^{13}\text{CO}$  under conventional heating at 600 °C, (b)  $^{13}\text{CO}_2$  under conventional heating at 600 °C, (c)  $^{13}\text{CO}$  under microwave heating at 490 °C, (d)  $^{13}\text{CO}_2$  under microwave heating at 490 °C.



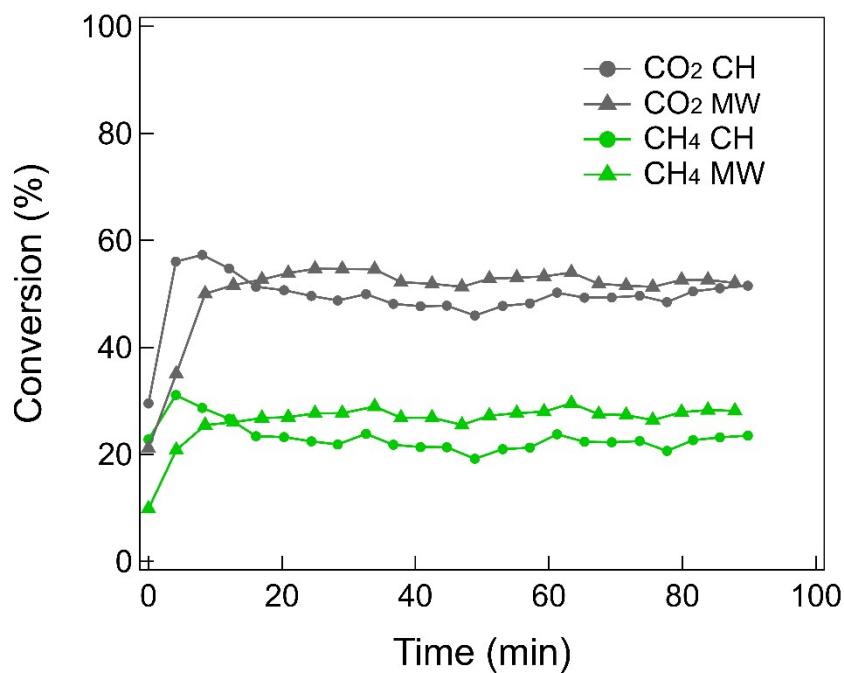


Figure S9. Catalytic activity during SSITKA under conventional heating (CH) at 600 °C and microwave heating (MW) at 490°C under the condition of CH<sub>4</sub>:CO<sub>2</sub> = 2:1.

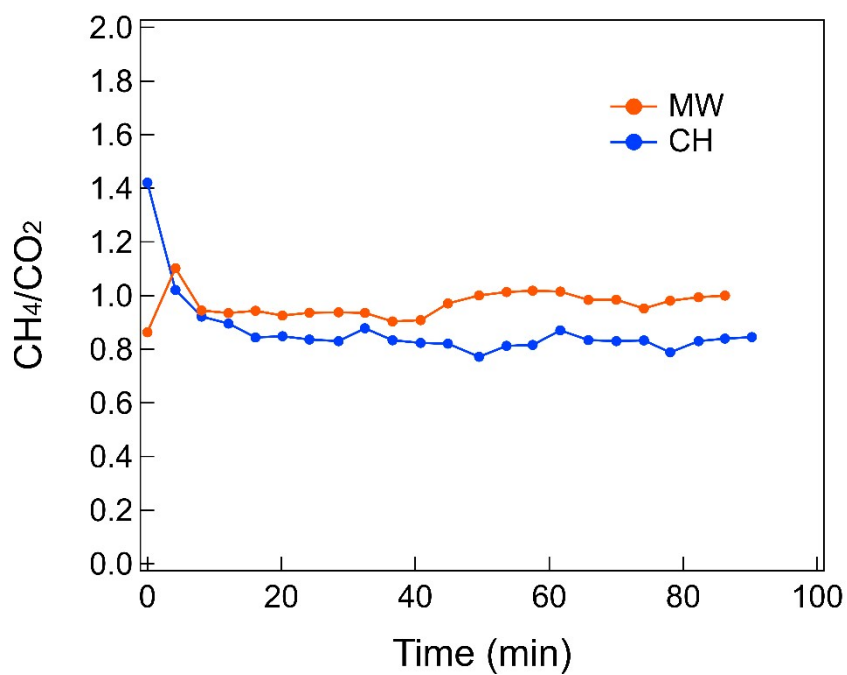


Figure S10. Ratio of converted CH<sub>4</sub>/CO<sub>2</sub> during SSITKA under conventional heating (CH) and microwave heating (MW) under the condition of CH<sub>4</sub>:CO<sub>2</sub> = 2:1.

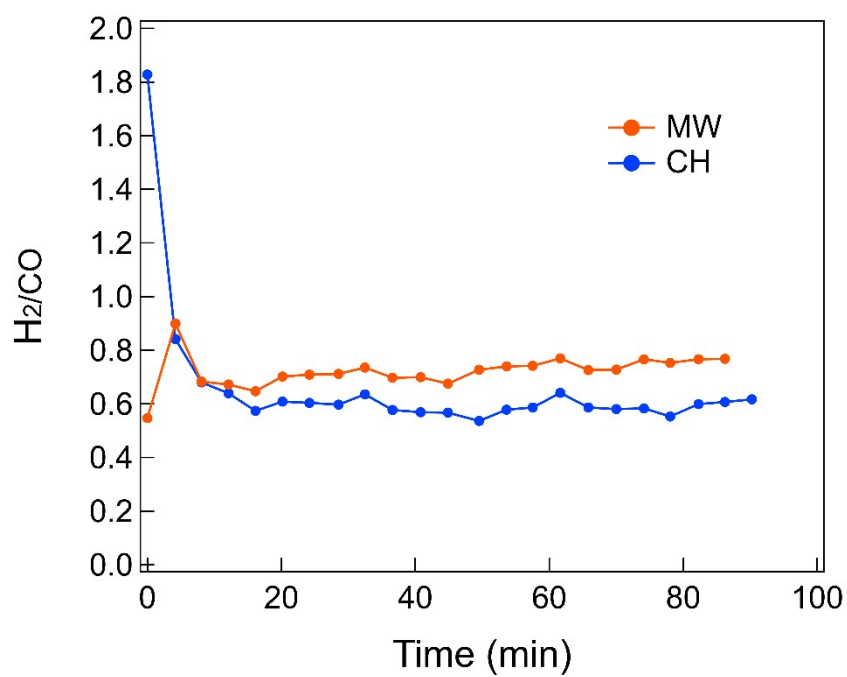


Figure S11. Ratio of produced H<sub>2</sub>/CO during SSITKA under conventional heating (CH) and microwave heating (MW) under the condition of CH<sub>4</sub>:CO<sub>2</sub> = 2:1.

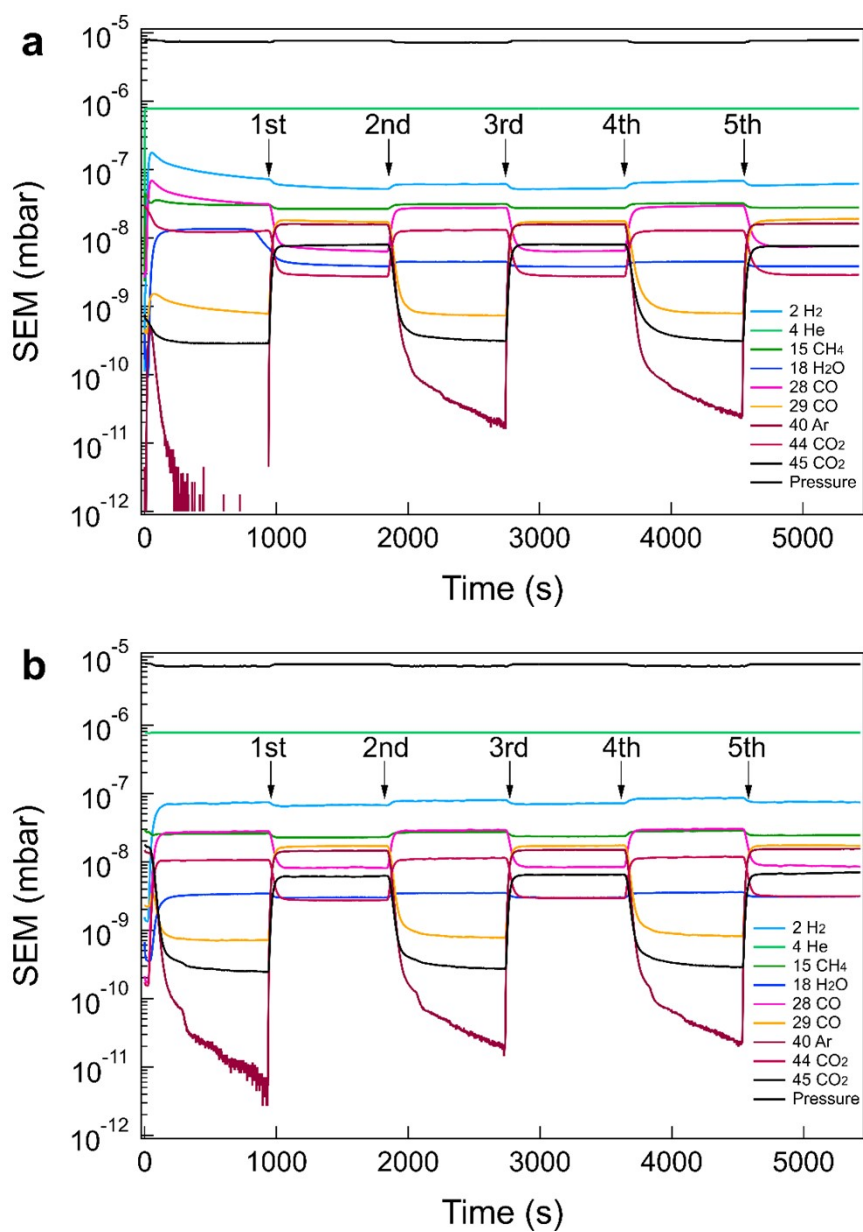


Figure S12. MS signal responses during SSITKA under (a) conventional heating at 600 °C and (b) microwave heating at 490 °C. The reactant switching between <sup>12</sup>CO<sub>2</sub> and <sup>13</sup>CO<sub>2</sub> was repeated five times under the condition of CH<sub>4</sub>:CO<sub>2</sub> = 2:1.

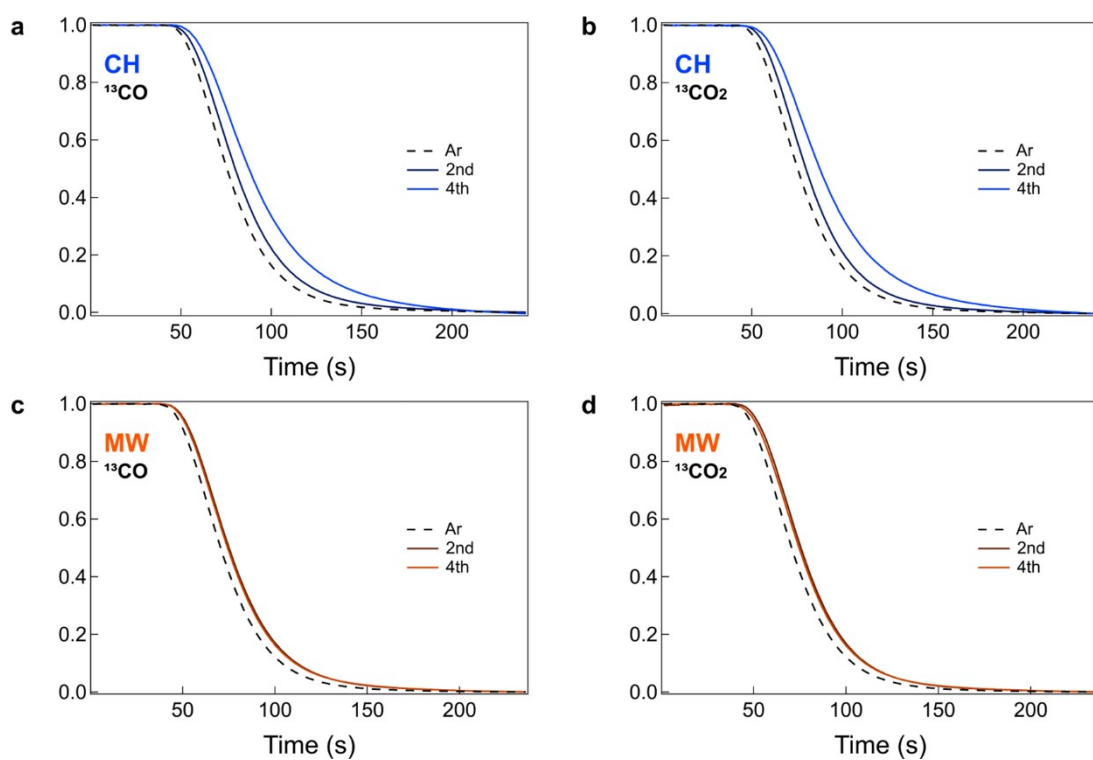


Figure S13. Normalized and overlaid 2<sup>nd</sup> and 4<sup>th</sup> switches of MS signals under the condition of  $\text{CH}_4:\text{CO}_2 = 2:1$ . (a)  $^{13}\text{CO}$  under conventional heating at 600 °C, (b)  $^{13}\text{CO}_2$  under conventional heating at 600 °C, (c)  $^{13}\text{CO}$  under microwave heating at 490 °C, (d)  $^{13}\text{CO}_2$  under microwave heating at 490 °C.

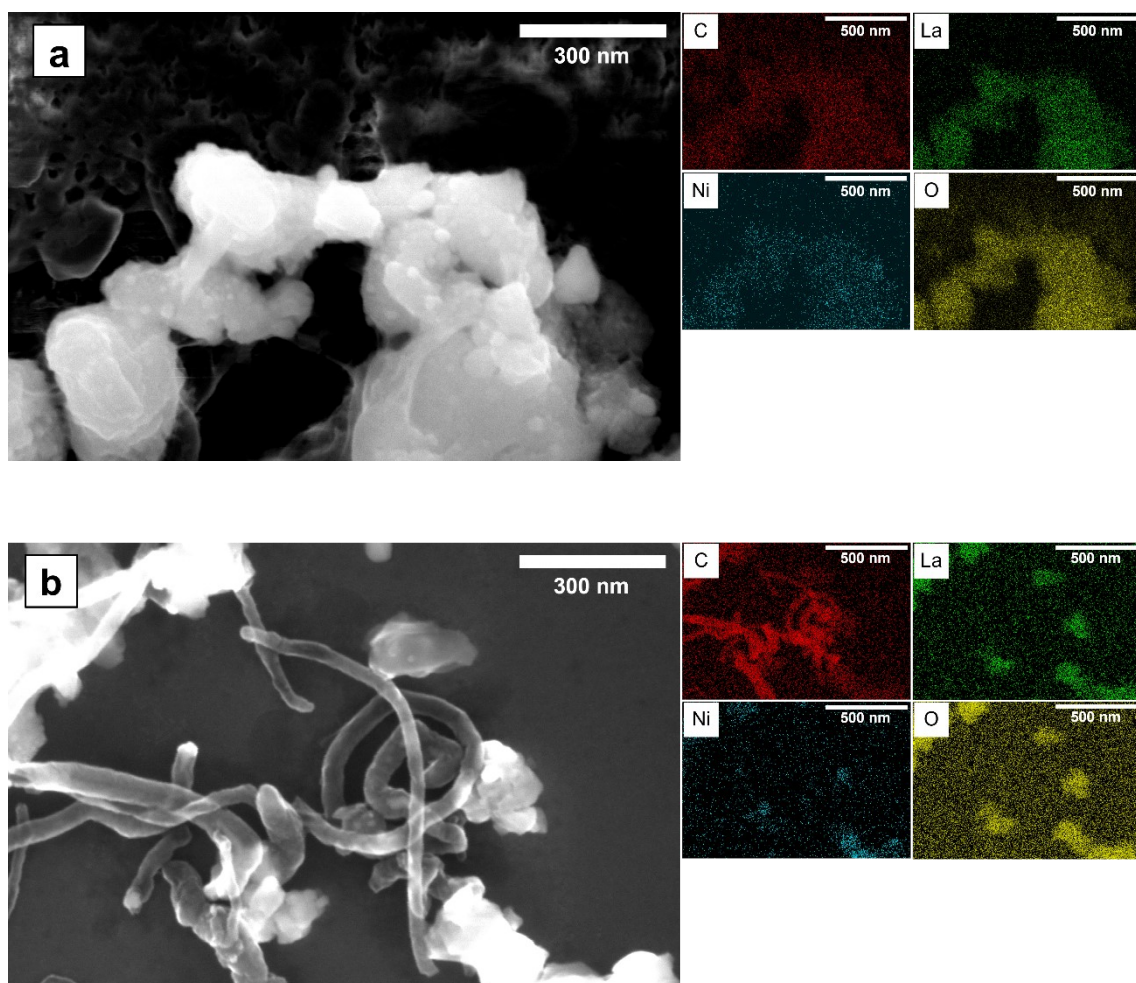


Figure S14. SEM images and element map of C, La, Ni, and O using EDS for spent catalysts after (a) conventional and (b) microwave heating under the condition of  $\text{CH}_4:\text{CO}_2 = 2:1$ .

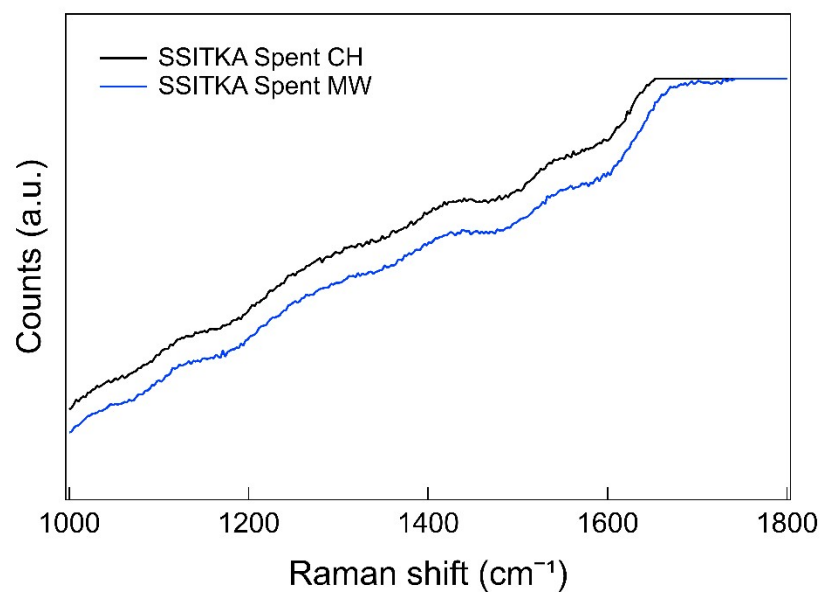


Fig. S15 Raman spectra of the spent catalysts after SSITKA experiments under conventional heating (CH) and microwave heating (MW)

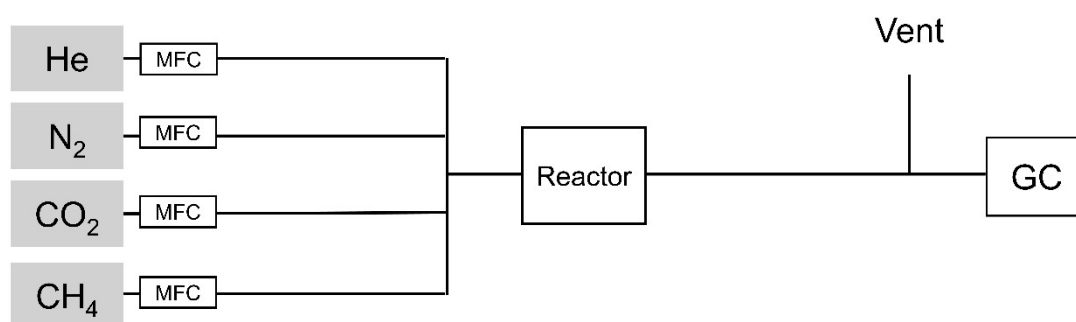


Figure S16. Experimental setup scheme. The setup is identical for both conventional heating and microwave heating, except for the reactor.

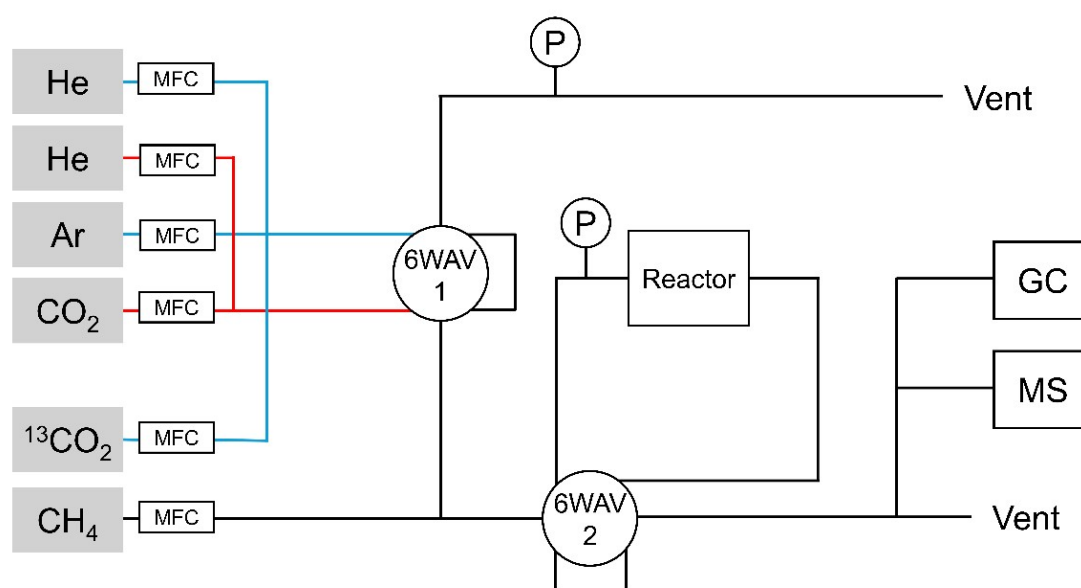


Figure S17. Experimental setup scheme for SSITKA. The setup is identical for both conventional heating and microwave heating, except for the reactor.