

Supplementary Materials

Synthesis of Catalytic Ni/Cu Nanoparticles from Simulated Wastewater on Li–Al Mixed Metal Oxides for a Two-Stage Catalytic Process in Ethanol Steam Reforming: Catalytic Performance and Coke Properties

Yu-Jia Chen ¹, Song-Hui Huang ¹, Jun-Yen Uan ^{1,2,*} and Hao-Tung Lin ³

¹ Department of Materials Science and Engineering, National Chung Hsing University, 145 Xingda Rd., Taichung 40227, Taiwan; t820207@gmail.com (Y.-J.C.); d099066006@mail.nchu.edu.tw (S.-H.H.)

² Innovation and Development Center of Sustainable Agriculture (IDCSA), National Chung Hsing University, 145 Xingda Rd., Taichung 40227, Taiwan

³ Green Energy and Environment Research Laboratories, Energy Storage System Department, New Energy Technology Division, Industrial Technology Research Institute, 195, Sec. 4, Chung Hsing Rd., Chutung, Hsinchu 31040, Taiwan; haotunglin@itri.org.tw

* Correspondence: jyuan@nchu.edu.tw

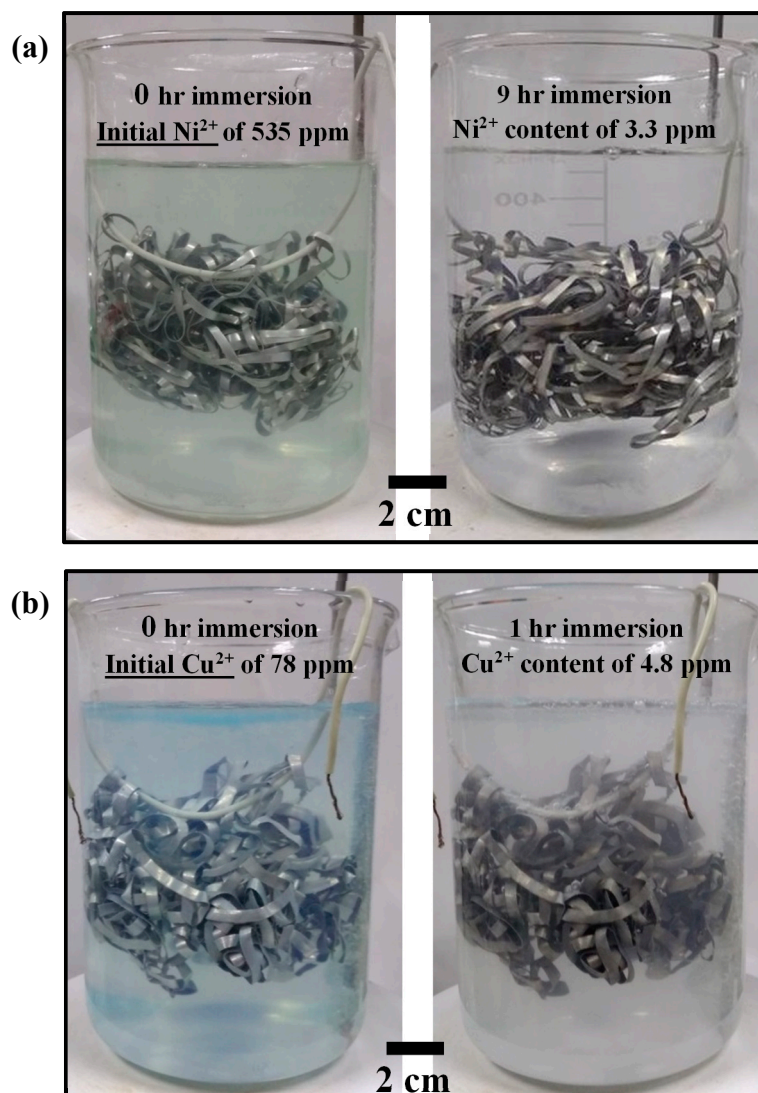


Figure S1. Recovering of Ni^{2+} (a) and Cu^{2+} (b) from the simulated wastewater were found, with the changes of the concentrations of: (a) Ni^{2+} from 535 ppm to 3.3 ppm between the initial and after the immersion time of nine-hour (by using three calcined LDH-coated frameworks consecutively, each was dipped for three hours); (b) Cu^{2+} decreased from 78 ppm to 4.8 ppm between the initial time and the immersion time of one hour. The concentration of the cations in the solutions was measured by an inductively coupled plasma optical emission spectrometer (ICP-OES, US, Agilent 5110 ICP-OES).

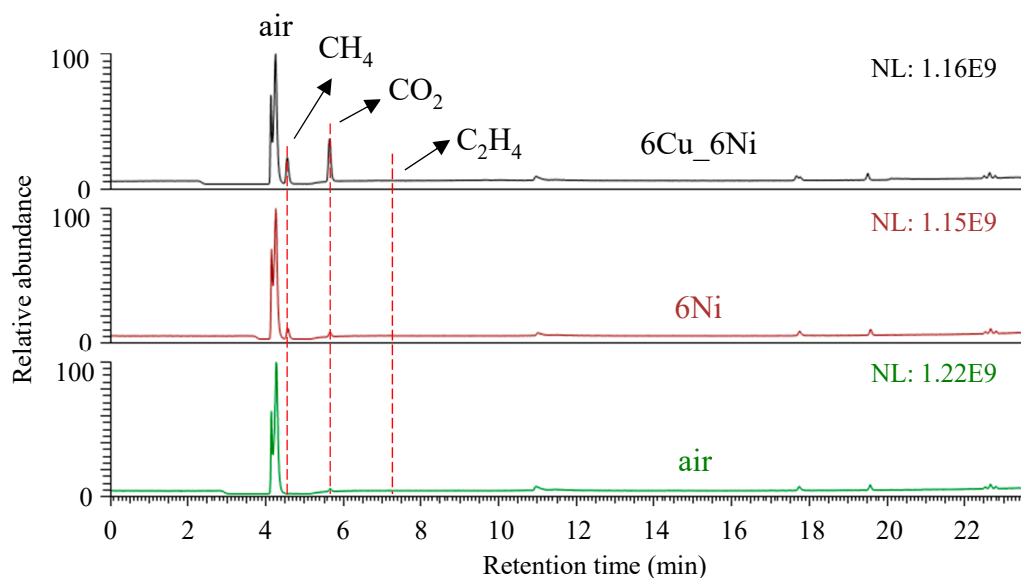


Figure S2. GC-MS results of gas-phase products for ESR over catalyst configurations which generate abundant gas (i.e. 6Ni and 6Cu_6Ni) at a reaction time of 1 hour compared with air atmosphere. NL means the normalization level. Reaction conditions: same as that described in Figure 7.

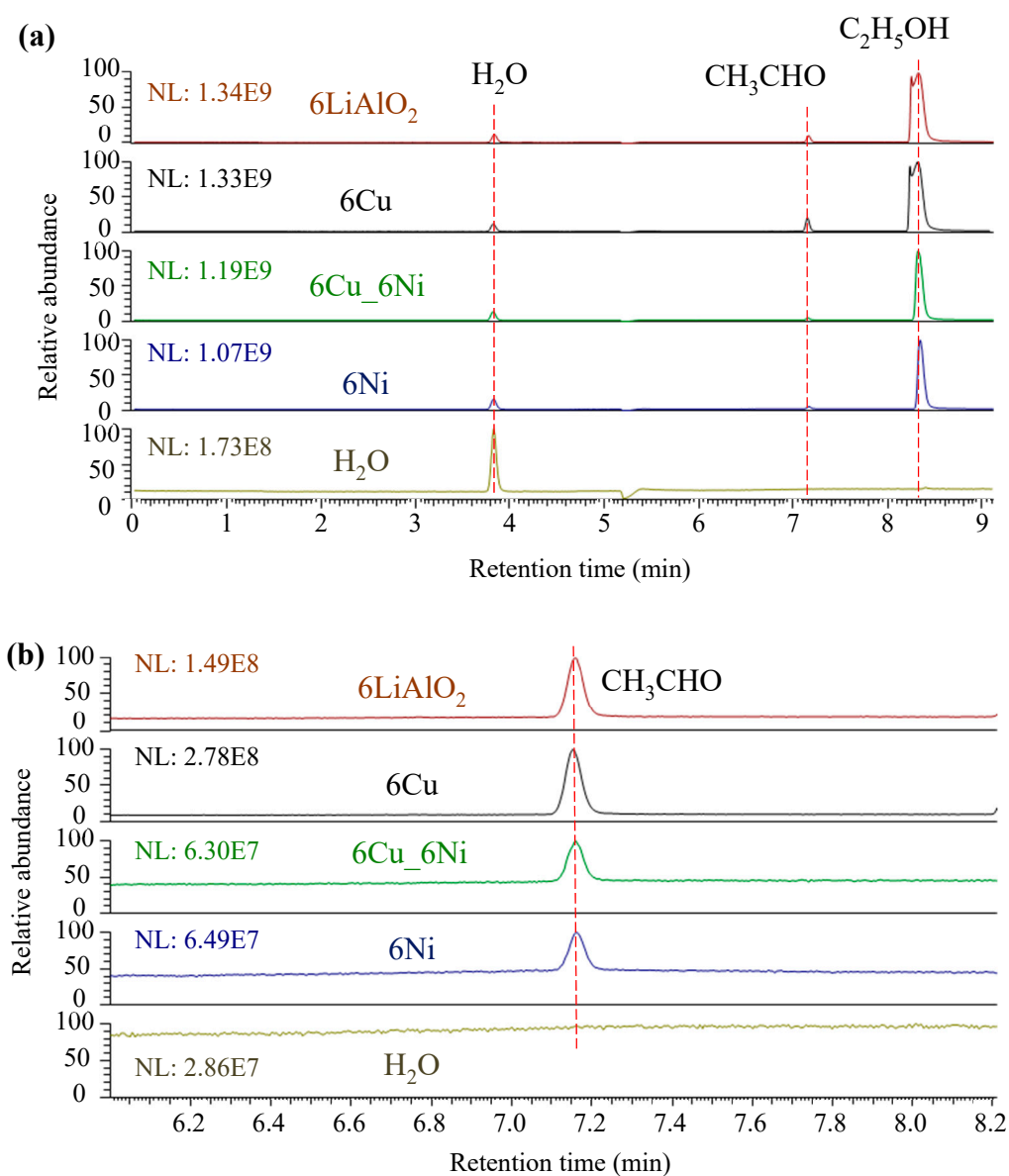


Figure S3. (a) GC-MS results of condensed liquid phase products for ESR over various catalyst configurations at a reaction time of 1 hour compared with H_2O ; (b) magnification view of the peaks corresponding to acetaldehyde. NL means the normalization level. Reaction conditions: same as that described in Figure 7.

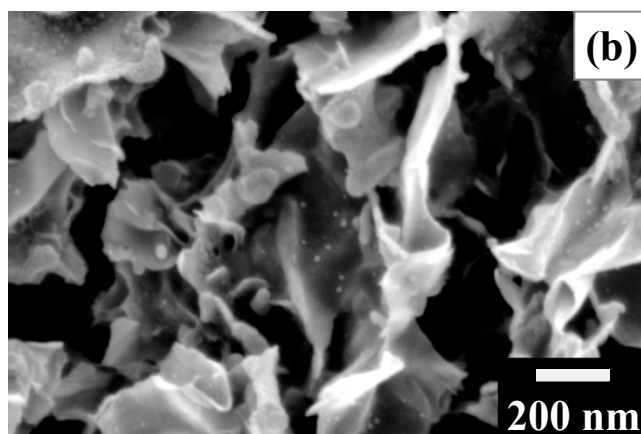
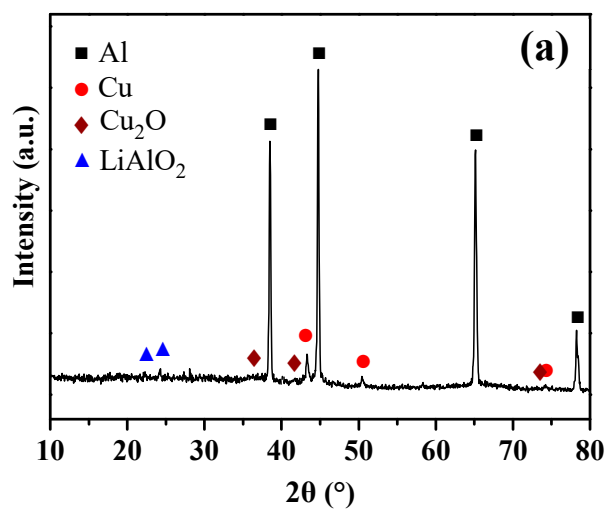


Figure S4. (a) XRD pattern; (b) SEM surface morphology of the spent Cu/LiAlO₂@6Cu₆Ni catalyst that was used in 5-hour reaction of ESR. Reaction conditions: same as that described in Figure 10.

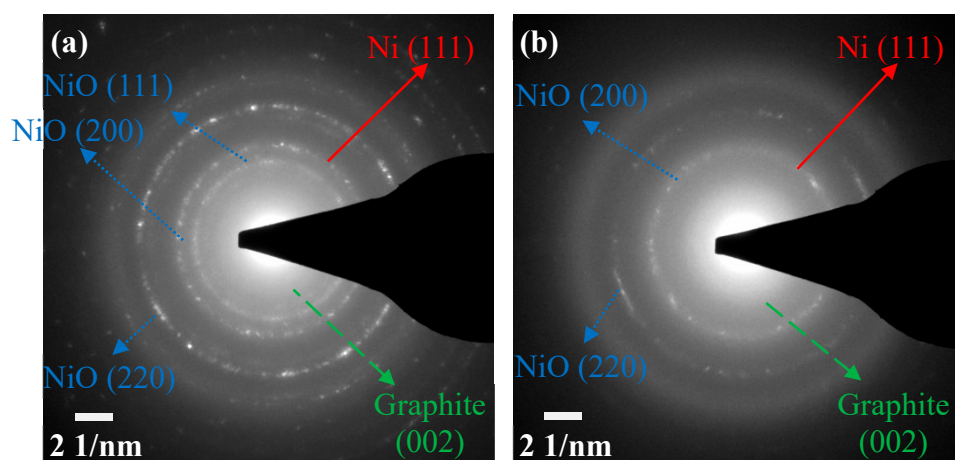


Figure S5. Selected area diffraction patterns of the particles on the spent catalysts that were used in 5-hour reactions of ESR: (a) Ni/LiAlO₂@6Ni; (b) Ni/LiAlO₂@6Cu₆Ni. Reaction conditions: same as that described in Figure 10.

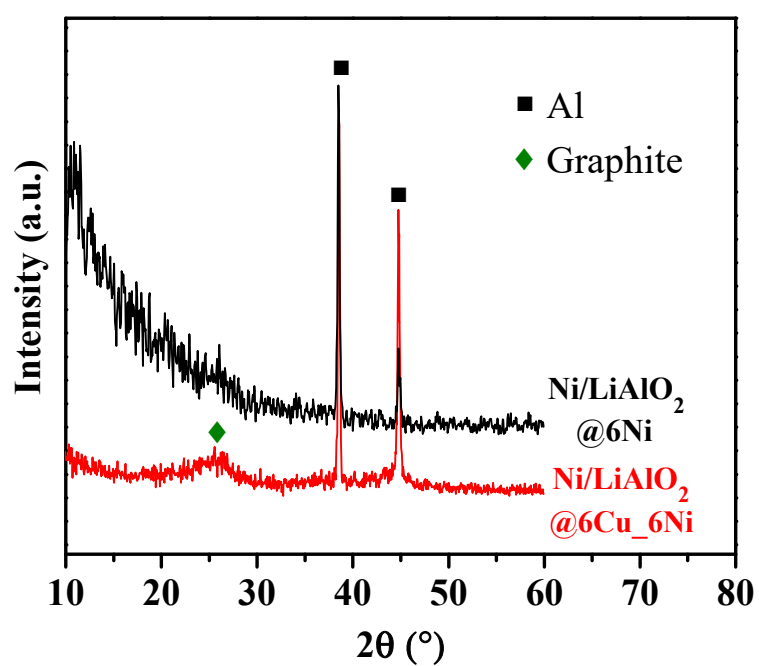


Figure S6. GAXRD patterns of the spent $\text{Ni/LiAlO}_2@6\text{Ni}$ and $\text{Ni/LiAlO}_2@6\text{Cu}_6\text{Ni}$ catalysts that were used in 5-hour reactions of ESR. Reaction conditions: same as that described in Figure 10.