

## Supplementary Information

### **Steam-assisted electro-reduction of NiO: A sustainable alternative to conventional hydrogen reduction**

Kaiyu Xie<sup>a,b</sup>, Ali Reza Kamali<sup>a,b\*</sup>

a) Energy and Environmental Materials Research Centre (E<sup>2</sup>MC), School of Metallurgy,  
Northeastern University, Shenyang 110819, China

b) Key Laboratory for Ecological Metallurgy of Multimetallic Mineral (Ministry of  
Education), Northeastern University, Shenyang 110819, China

\*E-mail: [ali@smm.neu.edu.cn](mailto:ali@smm.neu.edu.cn)

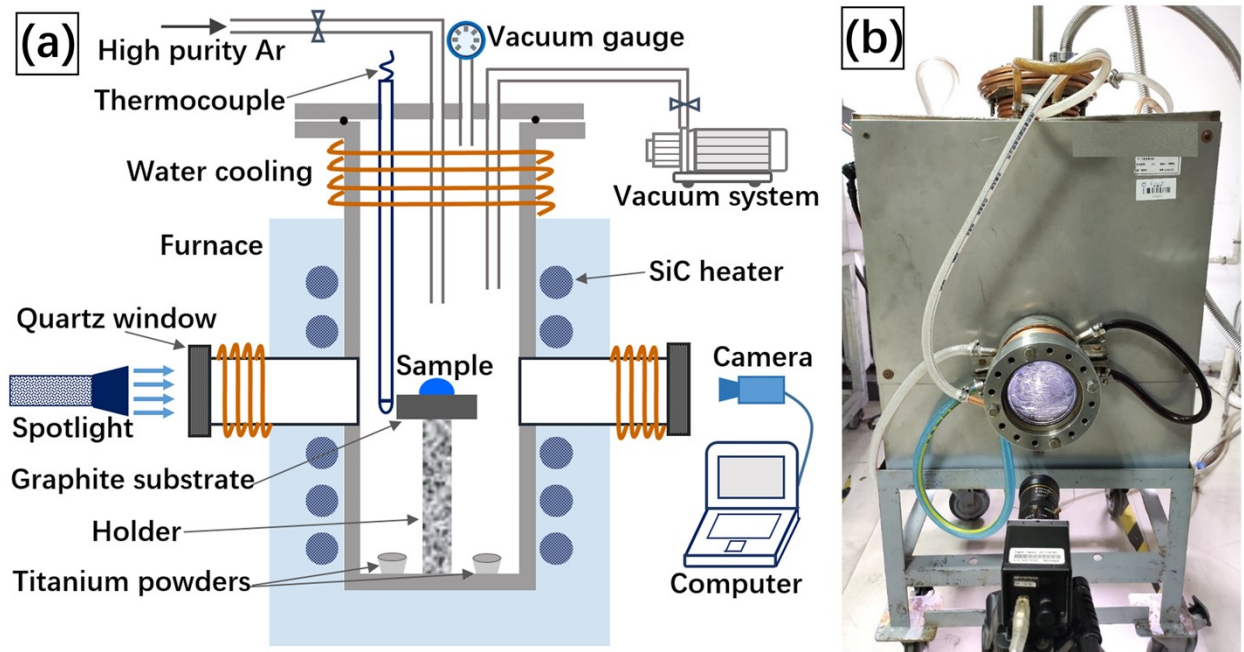


Fig. S1 (a) Schematic illustration and (b) the photograph of the setup used to evaluate the wettability of molten salt with graphite.



Fig. S2. The cross-section of electrolytic product under constant voltage of 1 V for 6h in LiCl melt.

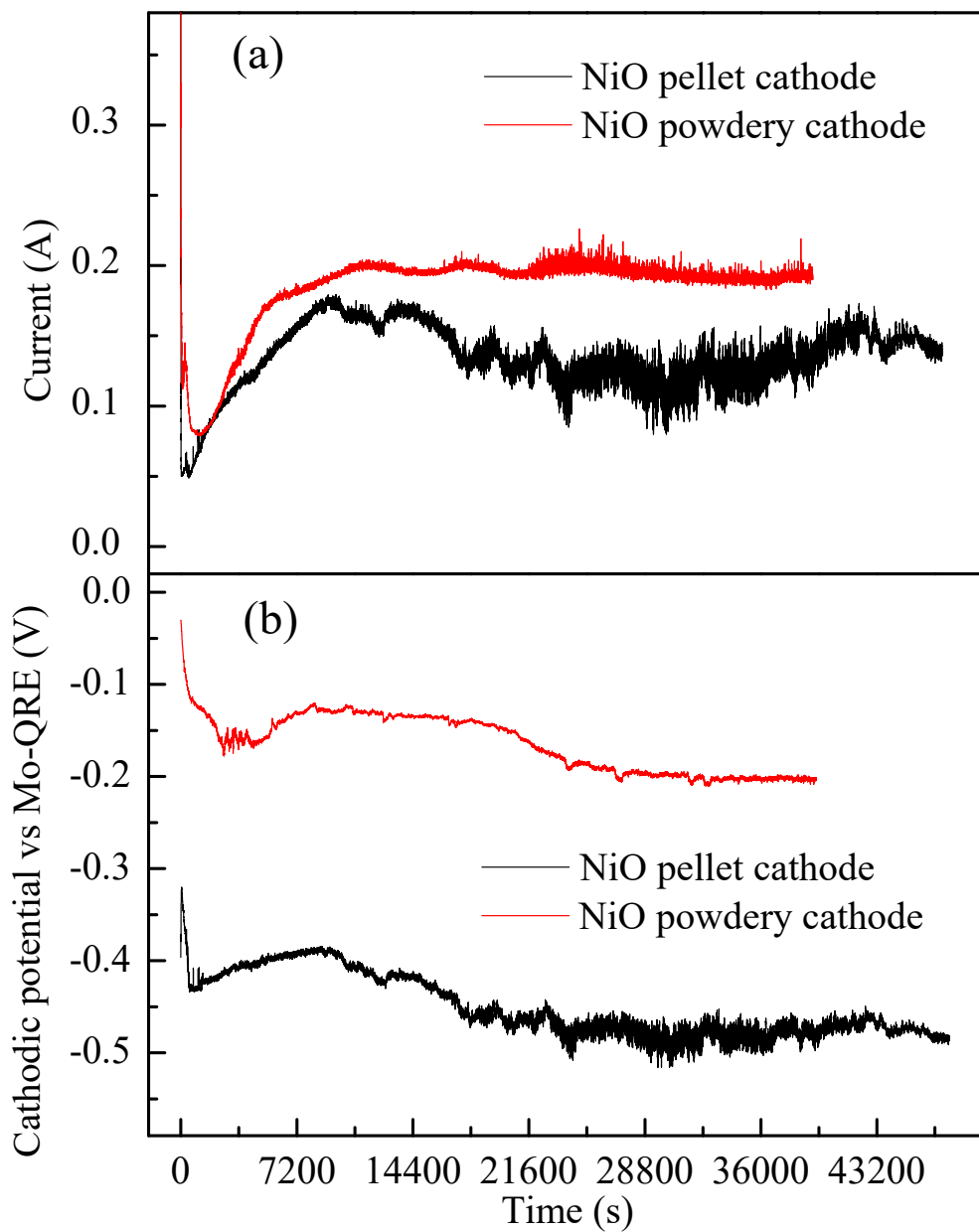


Fig. S3. The current, cathode and anode potential differences recorded during the constant voltage electrolysis under 1 V using pellet and powdery cathode, respectively.

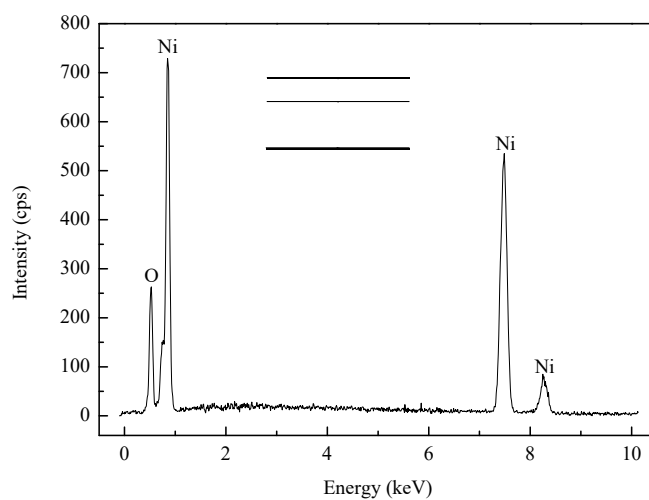
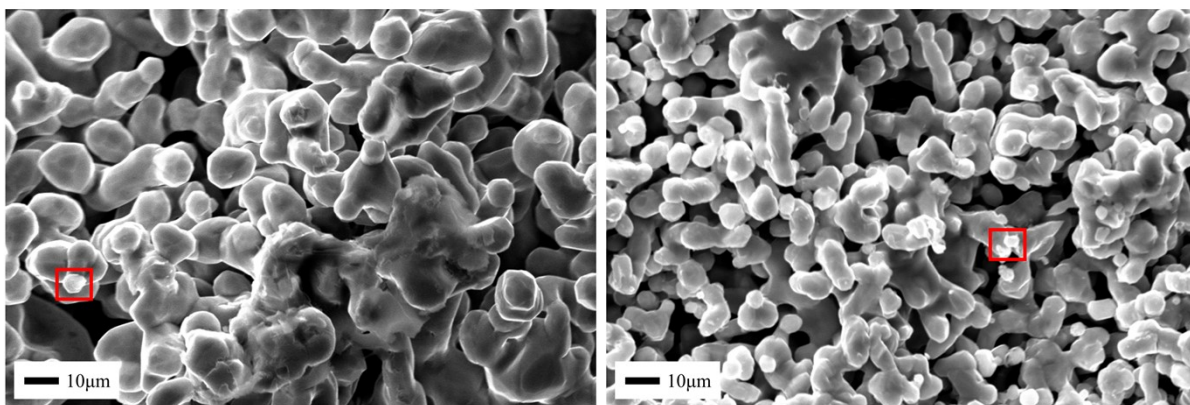


Fig. S4. SEM images of electrolytic products under 1.2 V (upper-left) and 1.3 V (upper-right) in LiCl melt for 8h., and EDS spectrum from the marked area in upper-left image.

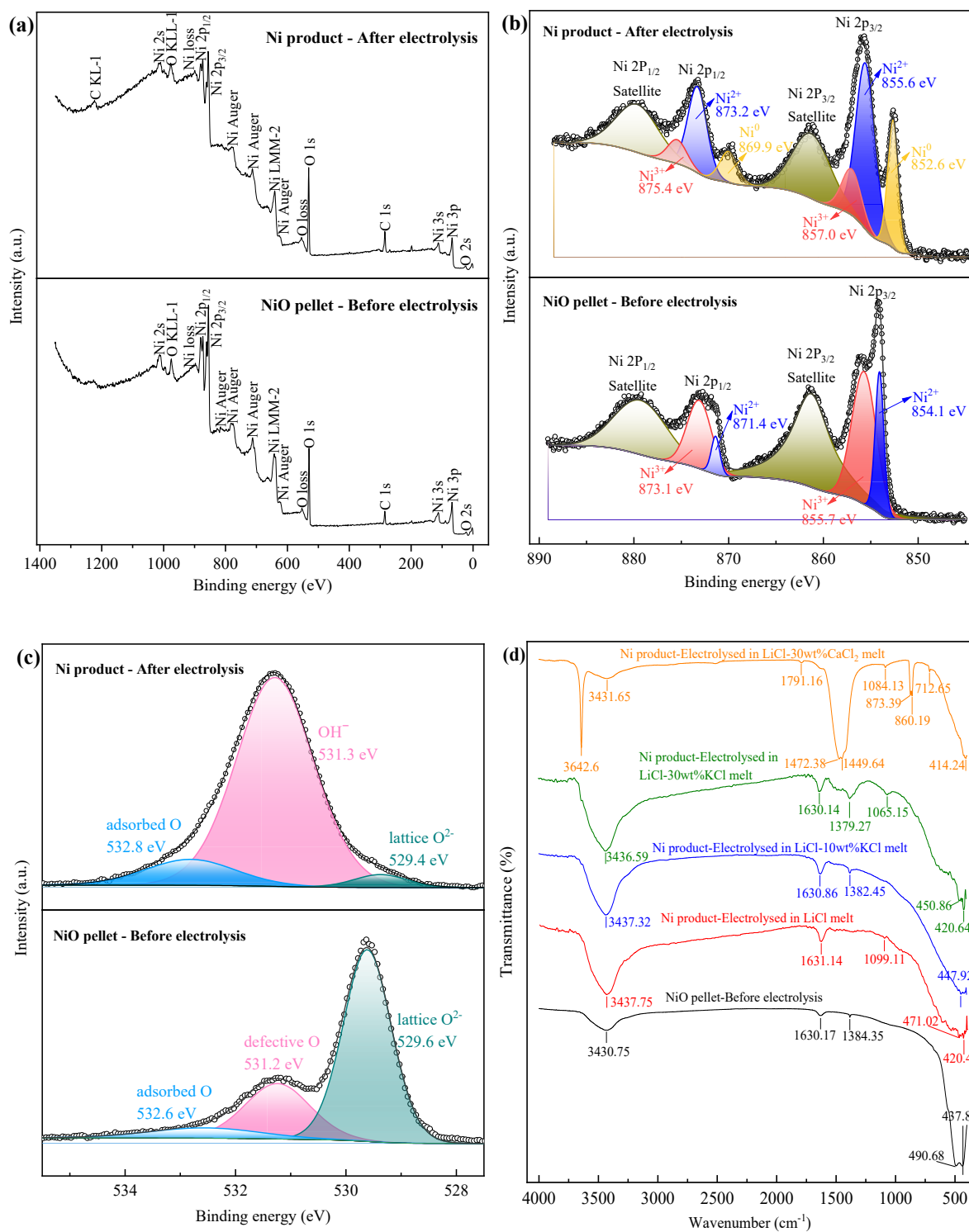


Fig. S5. (a-c) XPS spectra of NiO pellet before electrolysis and Ni product after electrolysis at 1.4 V in molten LiCl at 670 °C: (a) XPS survey spectra; (b) high resolution Ni 2p, and (c) and O 1s. (d) FTIR spectra of Ni products electrolyzed at 1.4 V in various electrolyte compositions.

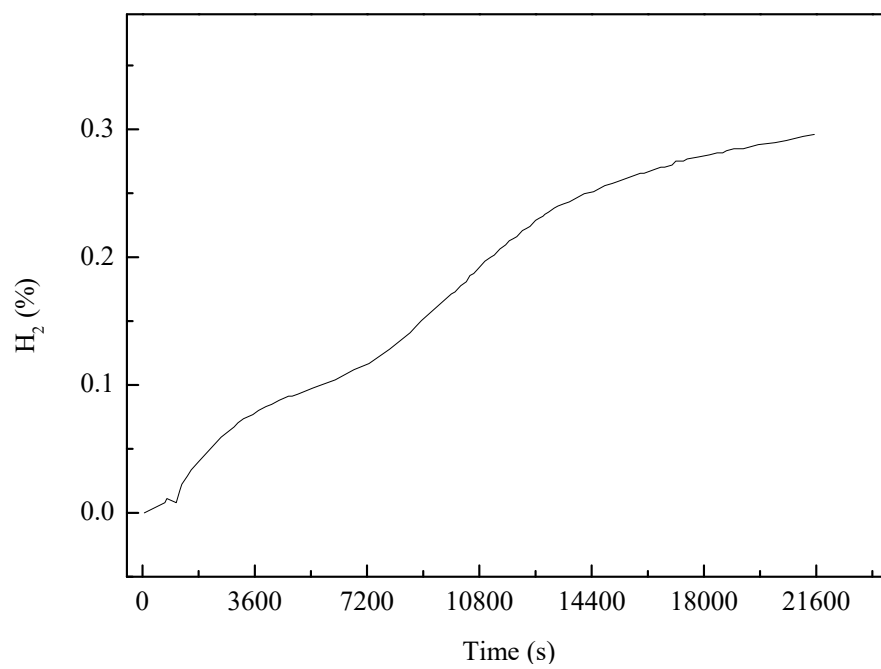


Fig. S6. The concentration of hydrogen–time curve via potentiostatic electrolysis of NiO pellet under 1.4 V in LiCl melt under moisturized atmosphere.

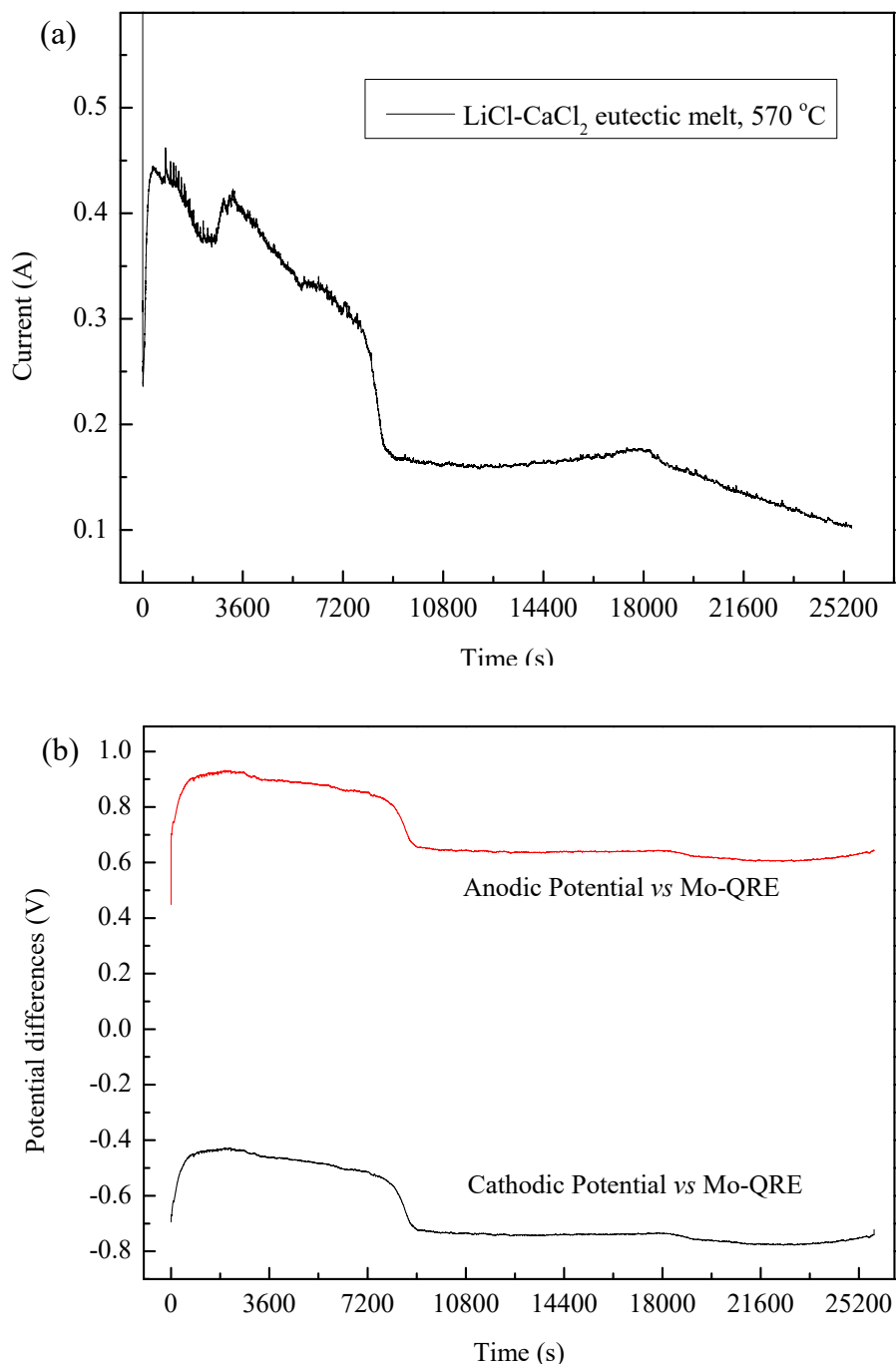


Fig. S7. (a) Current-time profiles under 1.4 V potentiostatic electrolysis in LiCl-58.5 wt.% CaCl<sub>2</sub> eutectic system at processing temperature of 570 °C under moisturized atmosphere. (b) The corresponding cathodic and anodic potential differences recorded during electrolysis.