Investigations on PVD Al/Ni electrocatalysts for alkaline water electrolysis

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Investigations on PVD Al/Ni electrocatalysts for alkaline water electrolysis

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1. Introduction

1.1 Alternative electrodes for alkaline electrolysis

- Manufacturing of low-cost and efficient electrodes for alkaline electrolysis, plays a crucial role in promotion of this technique as a suitable route for renewable energy storage.

1.2 Characterization of HER and OER properties

- A new method for manufacturing of Raney type electrodes were investigated and the electrodes were characterized using conventional electrochemical techniques.

2. Experimental and procedures

2.1 Manufacturing of electrodes

- Deposition of Al by physical vapour deposition onto Ni
- Diffusion of Al and Ni leaves a Raney alloy suitable as skeletal catalyst for increased gas evolution

3. Results and discussion

3.1 Diffusion

- Up to 30 minutes heat treatment of the Al/Ni couple at 600 ℃leads to a fast formation of leachable intermetallic phases (Al3Ni2, Al3Ni) (Figure 1)

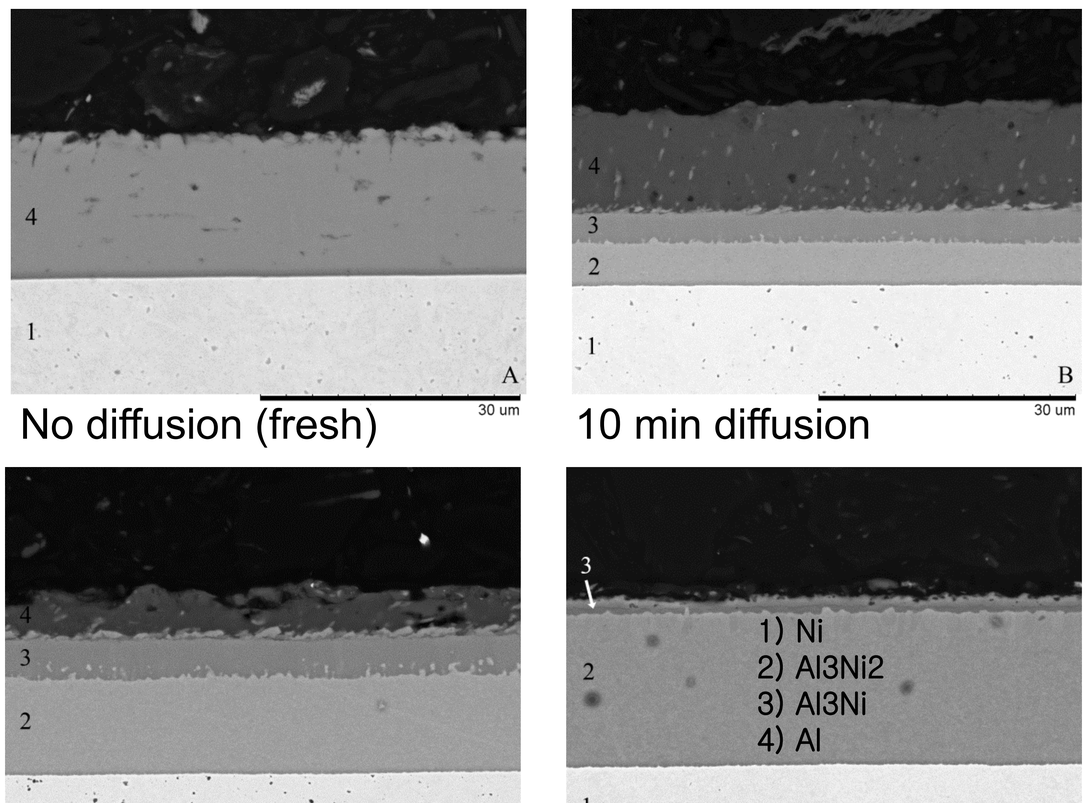

Figure 1: Diffusion of Al in Ni vs. time

- Columnar structure of the PVD Al results in fast grain boundary diffusion (Figure 2)

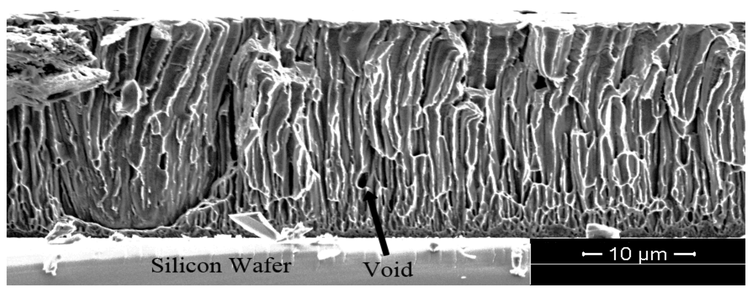

Figure 2: Columnar structure of PVD Al

3.2 Characterization of electrodes

- Hydrogen and oxygen evolution reactions were measured

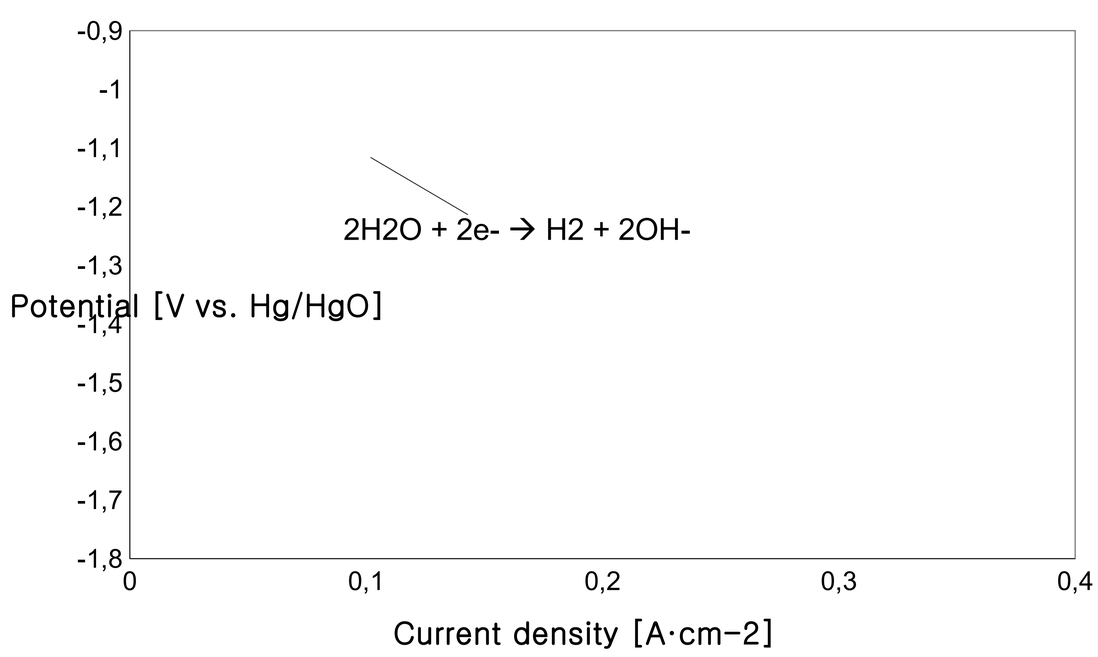

Figure 3: Overpotentials for hydrogen evolution

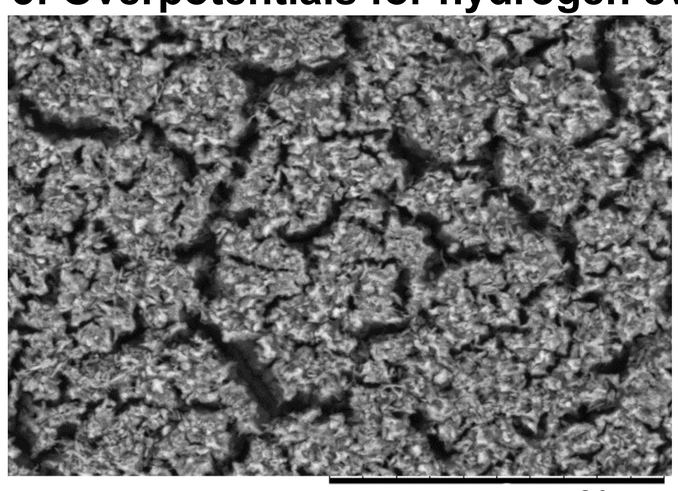

Figure 4: Top-view of activated NiAl surface

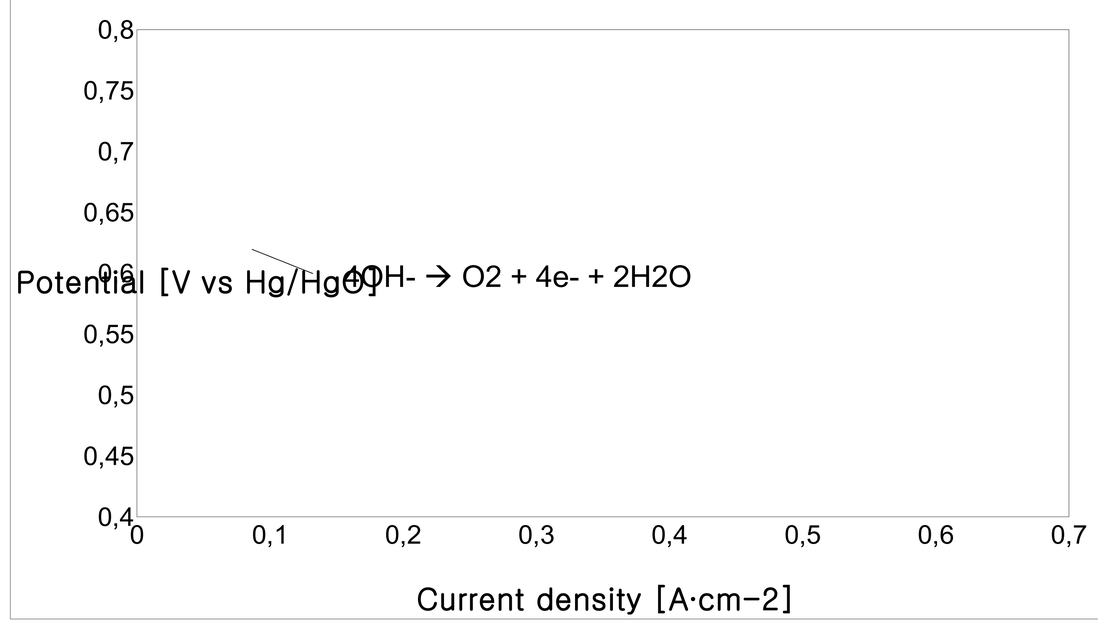

Figure 5: Overpotentials for oxygen evolution (OER)

4. Conclusion

- A porous and highly efficient electrode was created
- Fast diffusion of Nickel in columnar Aluminum occurred
- Longer diffusion times yielded higher HER activity.
- Only slight changes in activity for the OER with increased diffusion time
- HER overpotentials @100 mA/cm2 as low as 123 mV (385 mV lower than polished Ni)
- OER overpotentials @100 mA/cm2 as low as 338 mV (74 mV lower than polished Ni)