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Urea oxidation by electromediation of Ni(II)/Ni(III) system in alkaline media with simultaneous H₂ production

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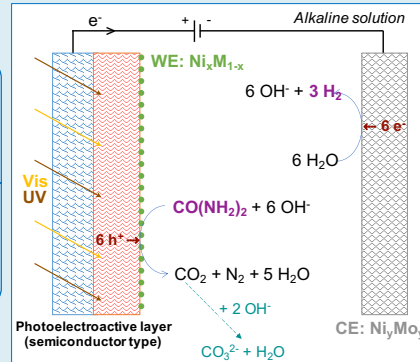
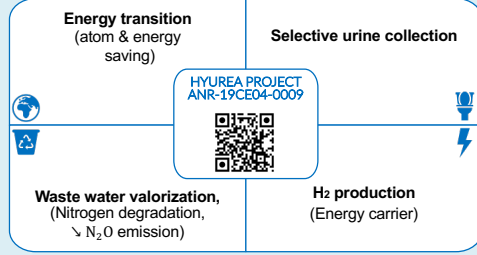
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Submitted on 23 Nov 2023

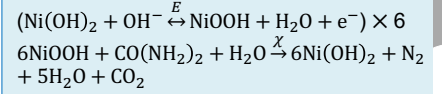
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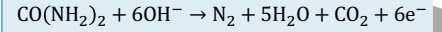
BACKGROUND



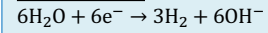
At the anode:



Anodic overall:



At the cathode:



METHODOLOGY



①/② Electrochemical study at lab scale

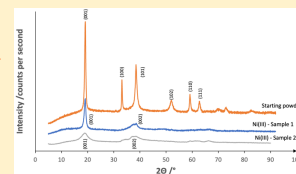
Electrolysis at lab-scale

Investigations of (electro)oxidation kinetic and mechanisms

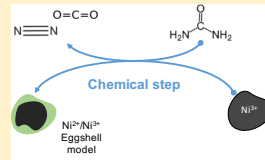
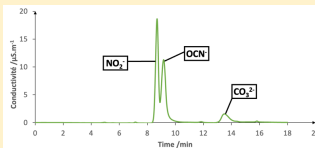
Effect of electrode, electrolyte, temperature,

pH, $i = f(S_{\text{electrode}}, E, [\text{CO}(\text{NH}_2)_2], [\text{KOH}])$

③ Structural characterizations (XRD, SEM)

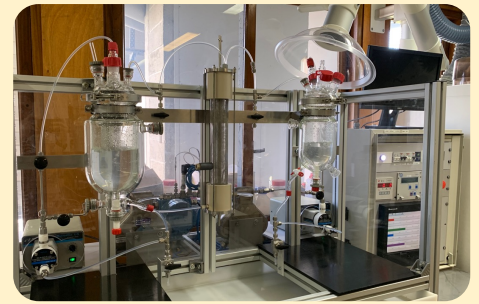


④ Analytical tools (ionic chromatography, mass spectroscopy)



⑤ Kinetic rate law determination

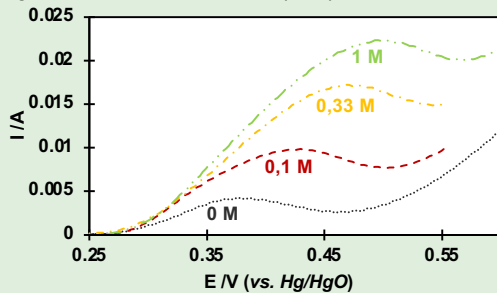
5 L. day. m⁻² electrode capacity



ANALYSIS - RESULTS

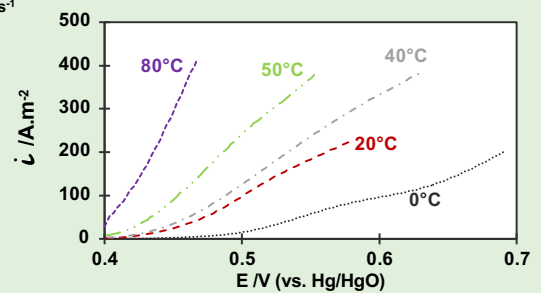
Influence of urea concentration

Voltammograms obtained on nickel electrode (4 cm²) in 3 M KOH solution at 50 mV.s⁻¹



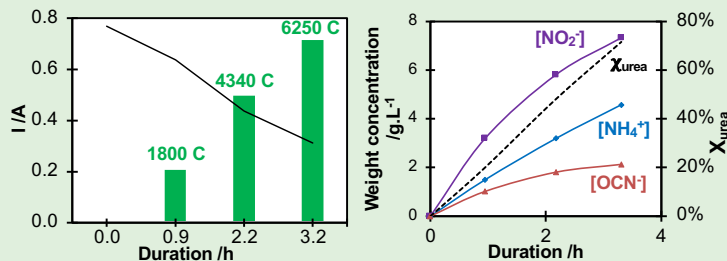
Influence of temperature

Voltammograms obtained on nickel electrode (4 cm²) in 3 M KOH / 0.33 M urea solution at 50 mV.s⁻¹



Mass balances of urea/byproducts (in the liquid phase) as well as current temporal evolution during potentiostatic electrolysis

at 0.5 V vs. Hg/HgO / 3 M KOH solution containing initial urea at 0.33 M / nickel anode (31 cm²) / undivided H-shaped reactor



CONCLUSIONS PERSPECTIVES

Parametric study
Kinetics rate law obtained and validated by modeling
Design and building of a pilot scale

Pilot scale experiments
Modeling & Simulation
Real human effluents
Photo-assistance integration