



# Enhanced Hydrogen Generation and Utilization using Femtosecond Laser-Nanostructured $\text{NiCo}_2\text{O}_4$ Electrocatalysts

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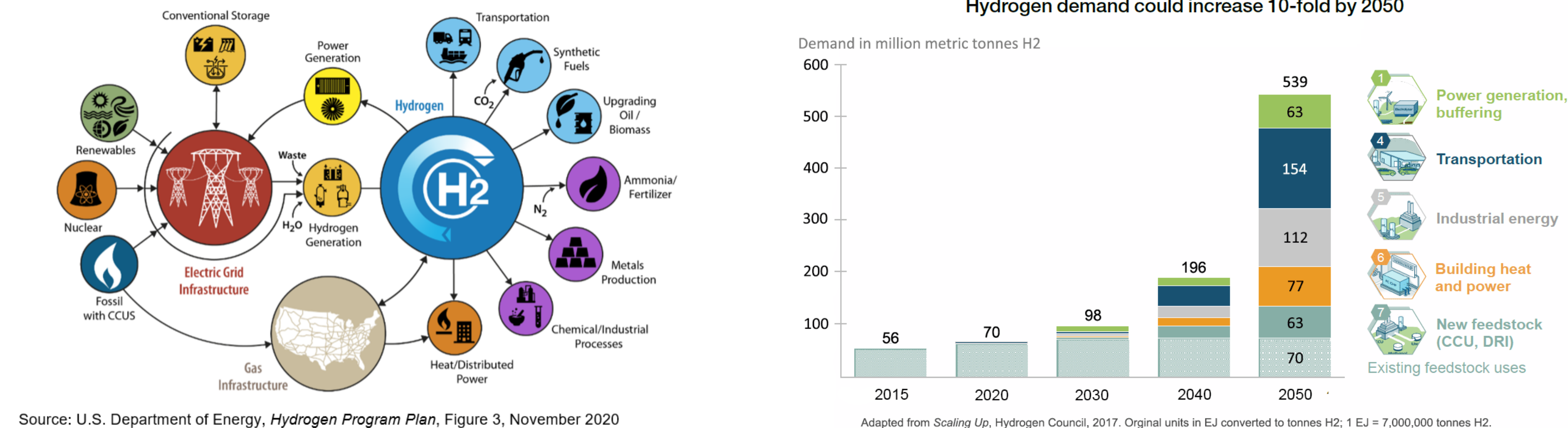
University of  
Nebraska-Lincoln

Laser-Assisted Nano-Engineering Lab

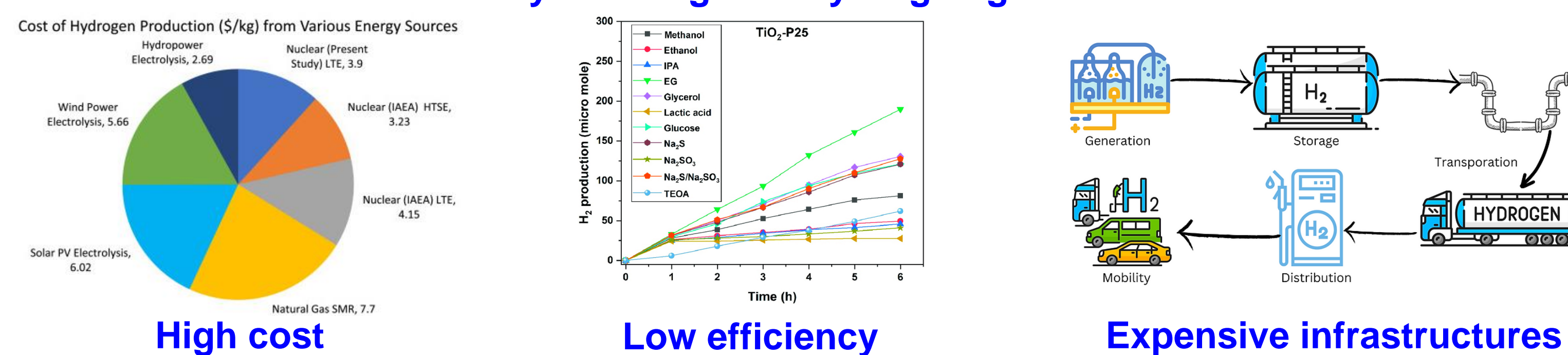
## Motivations and Challenges

### Increasing demand of hydrogen

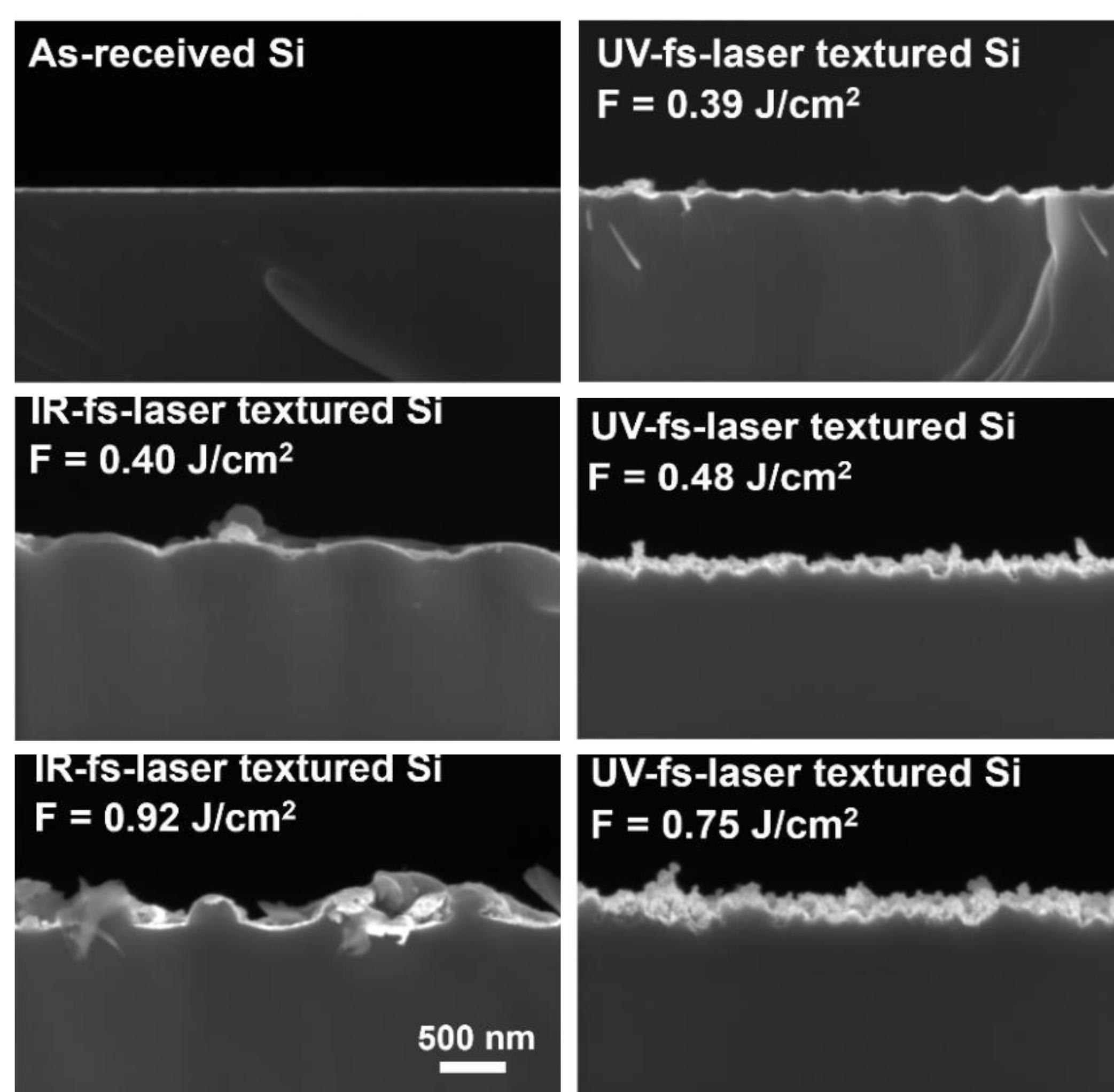
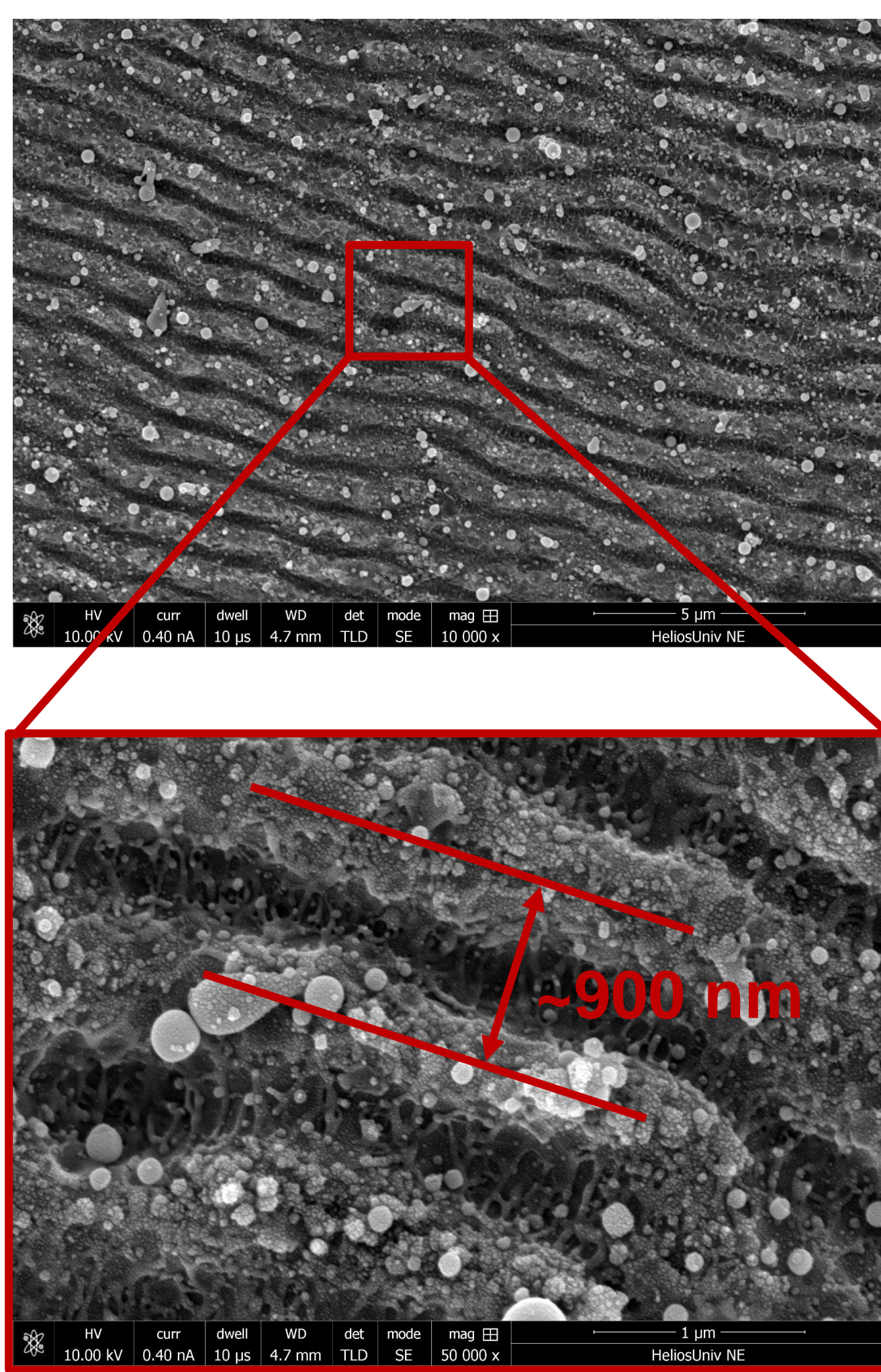
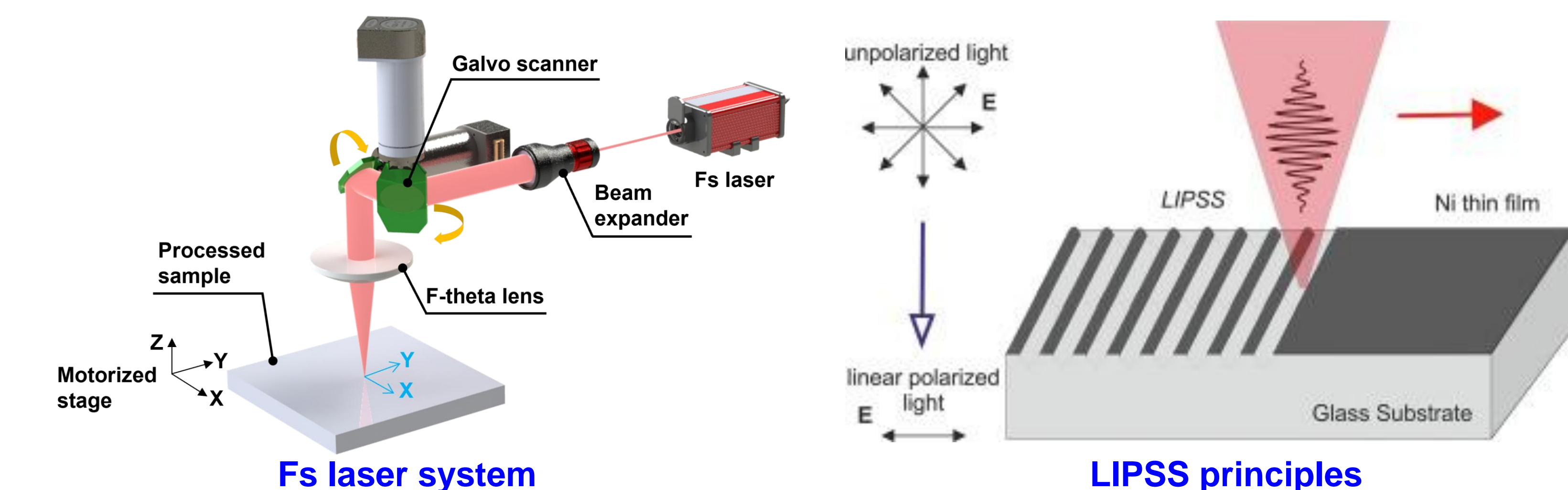
Hydrogen demand could increase 10-fold by 2050



### Key challenges in hydrogen generation



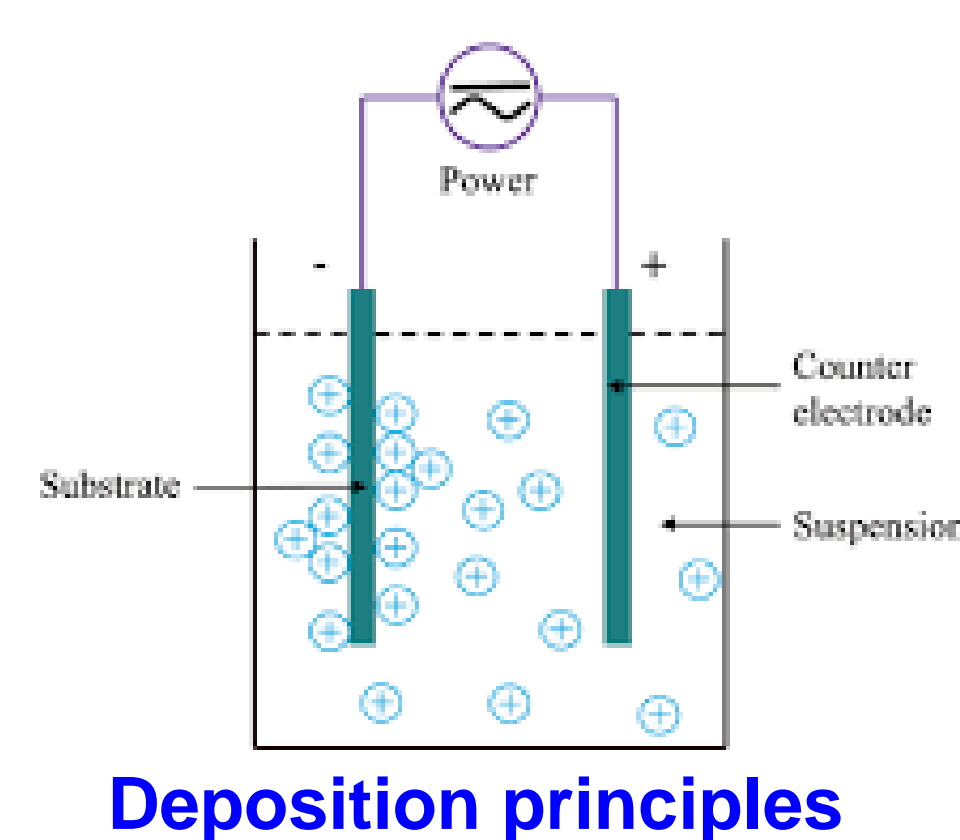
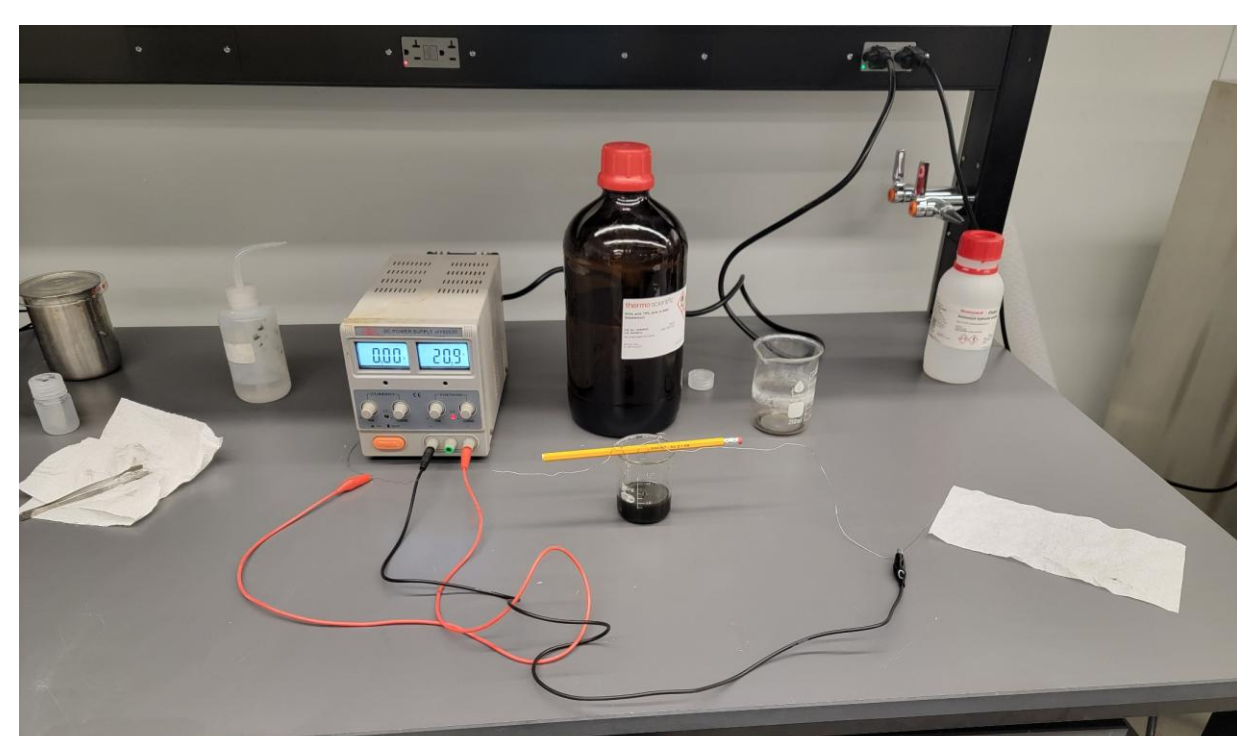
## Laser-induced periodic surface structures



SEM images of textured Ni substrates

SEM images of cross sections of Si nanoripples

## Deposition of $\text{NiCo}_2\text{O}_4$

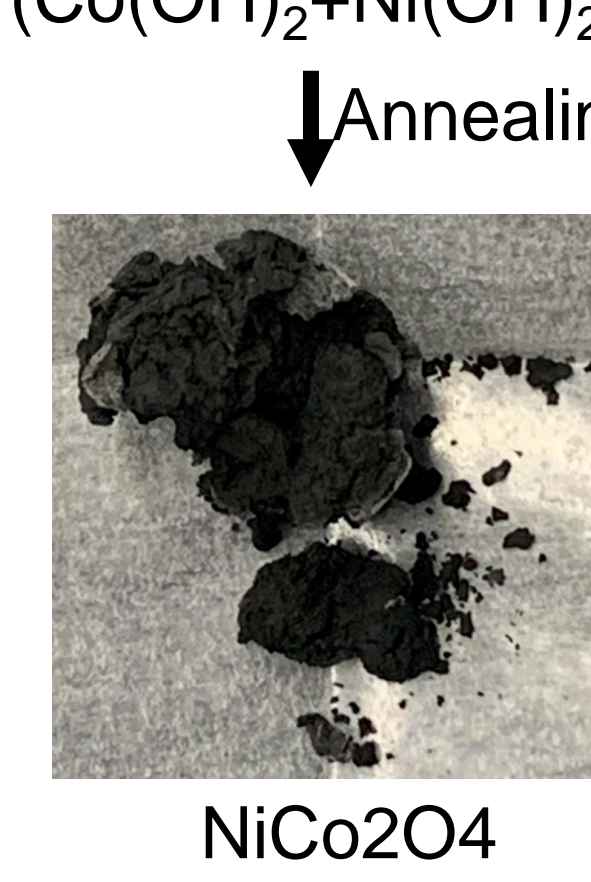
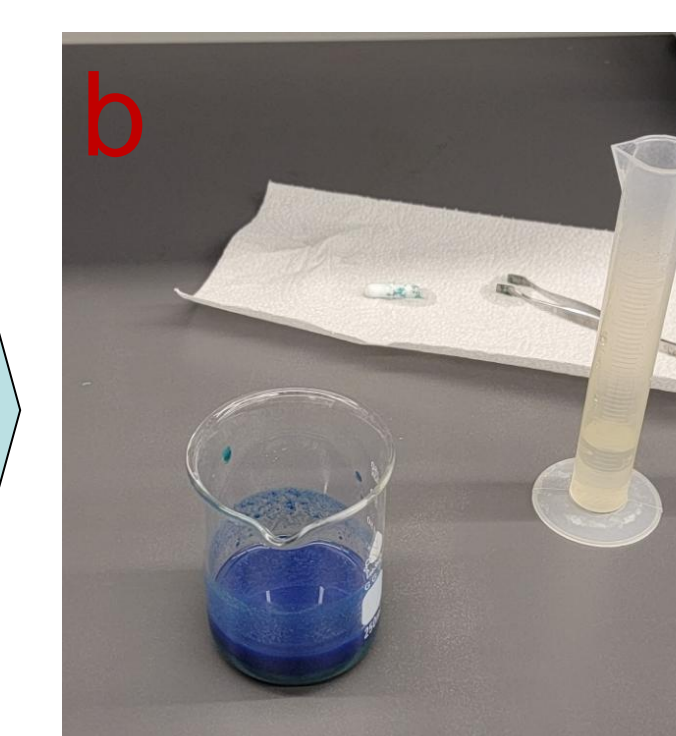
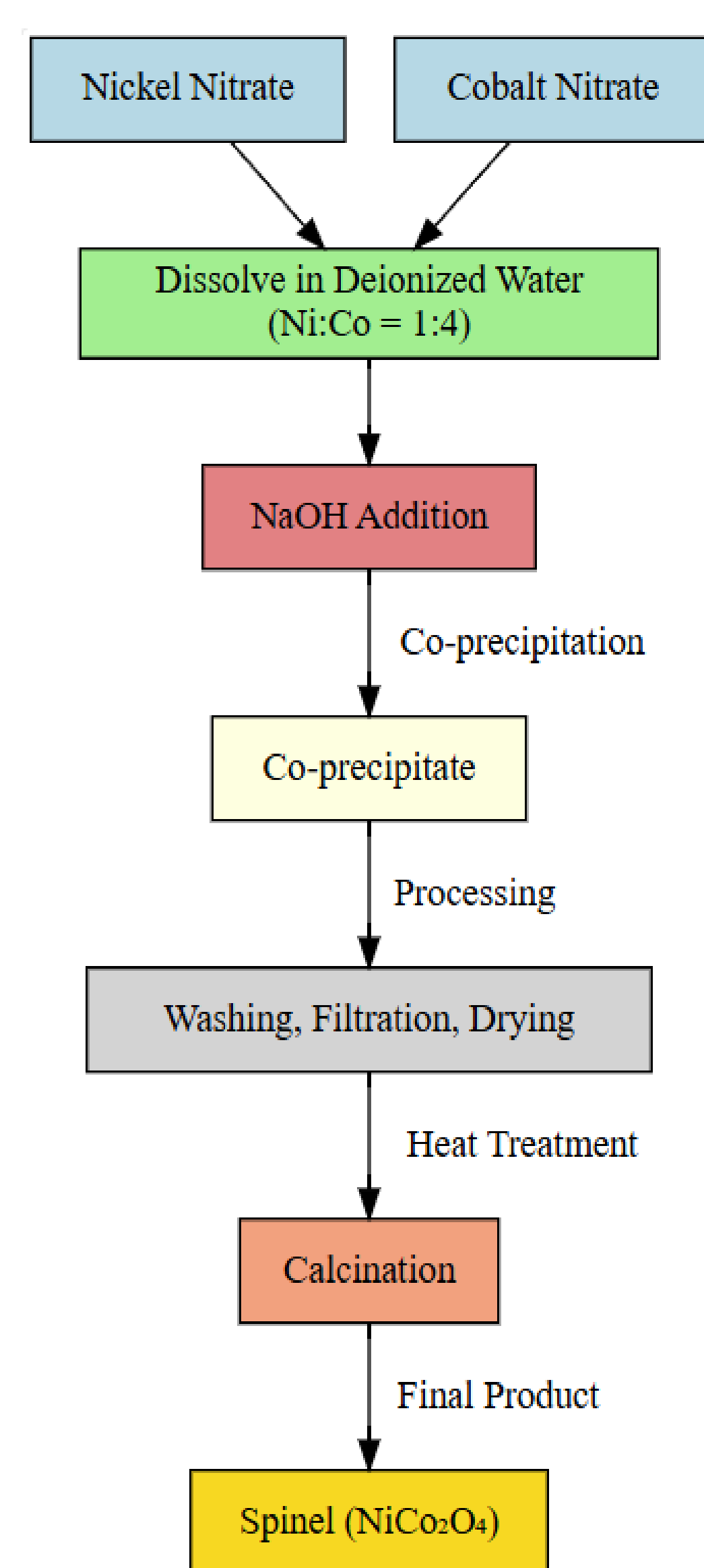


Deposition machine

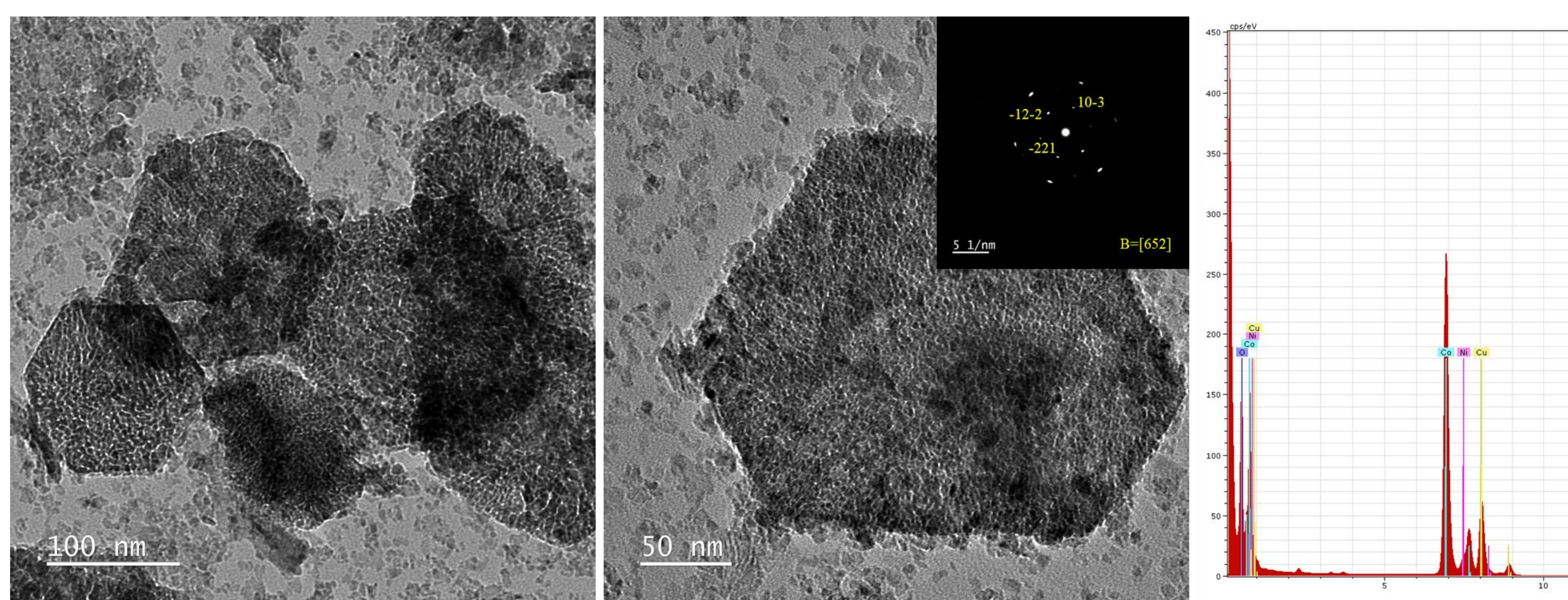
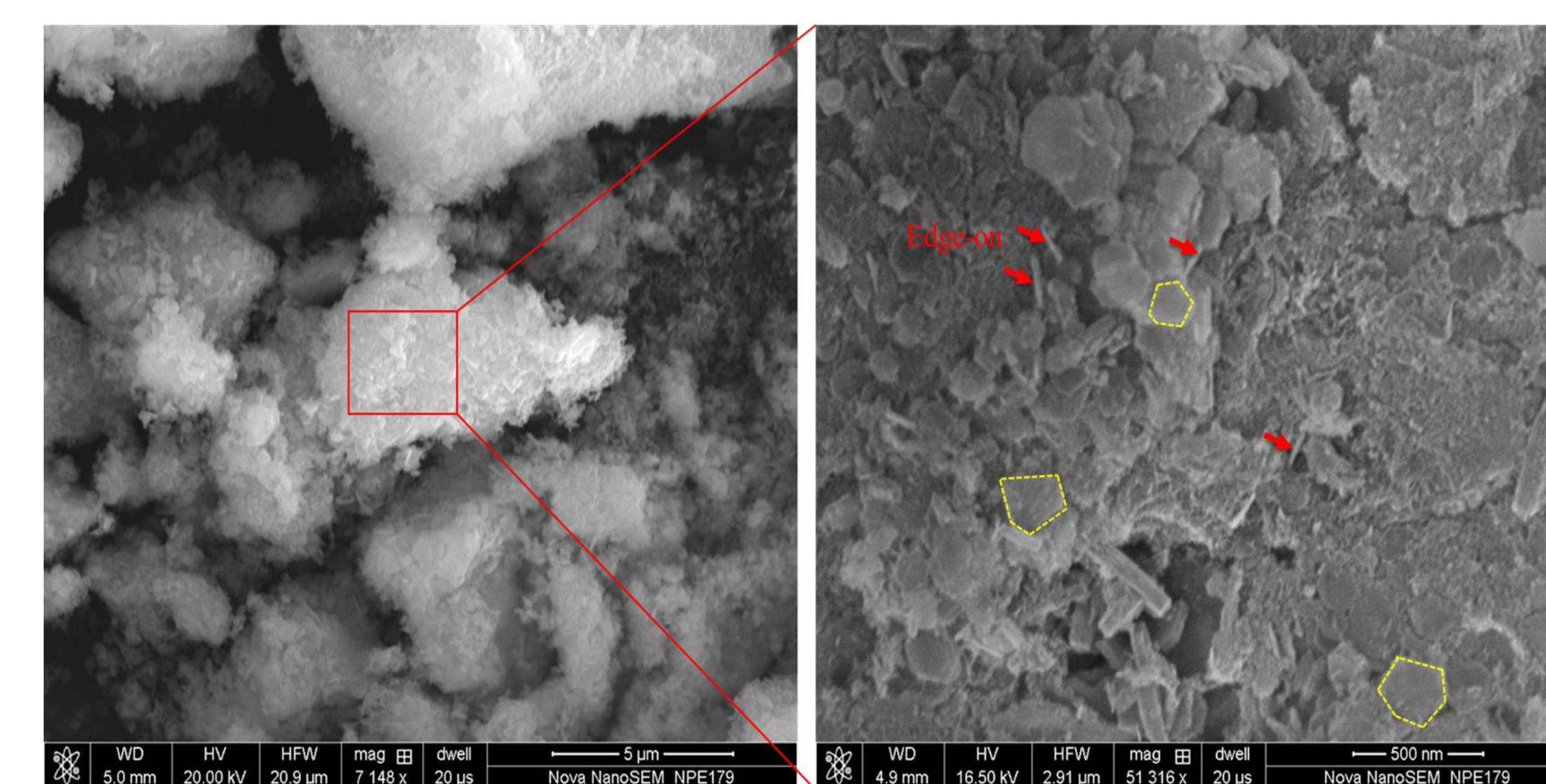
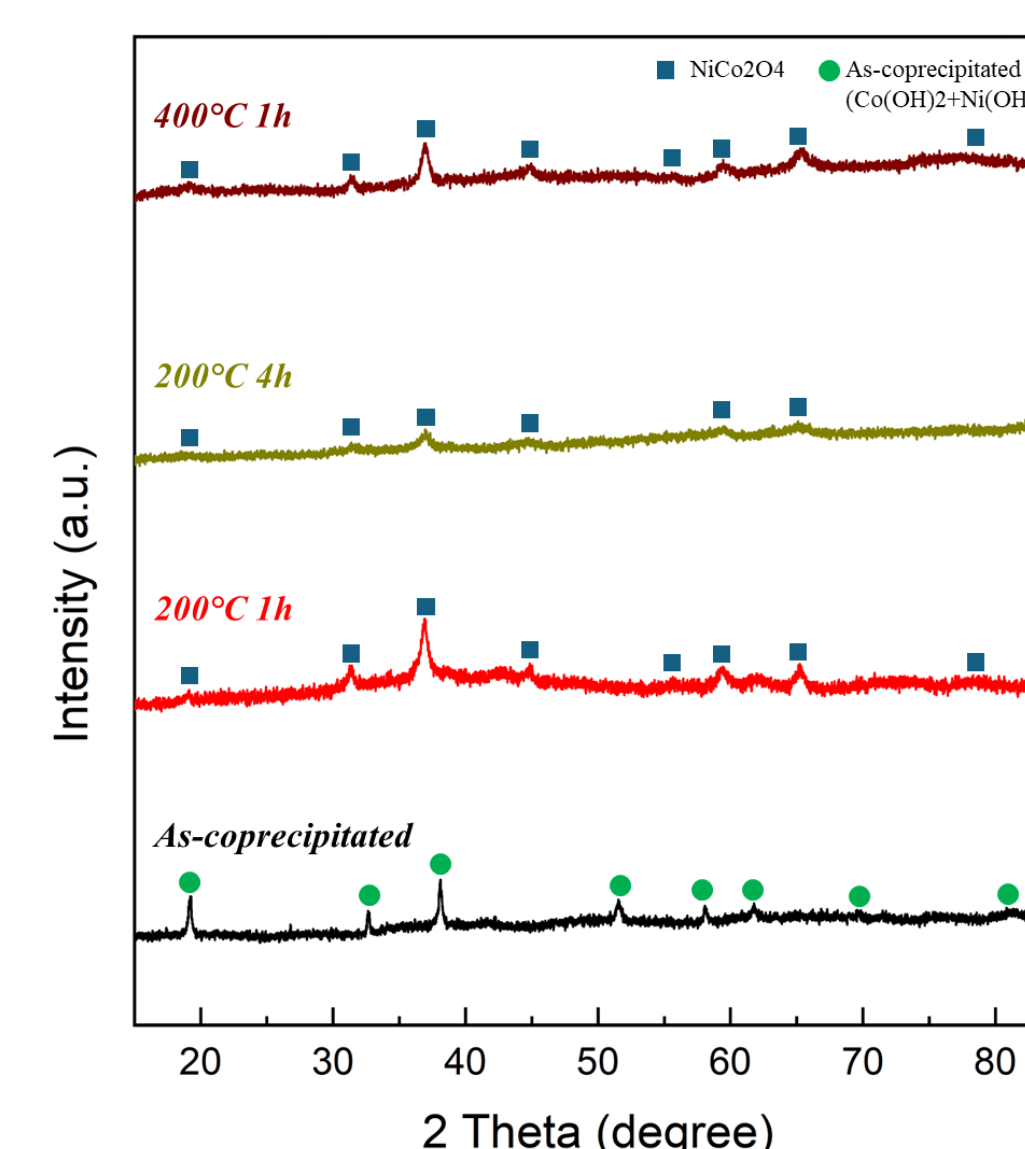
Deposition principles

## Synthesis of $\text{NiCo}_2\text{O}_4$

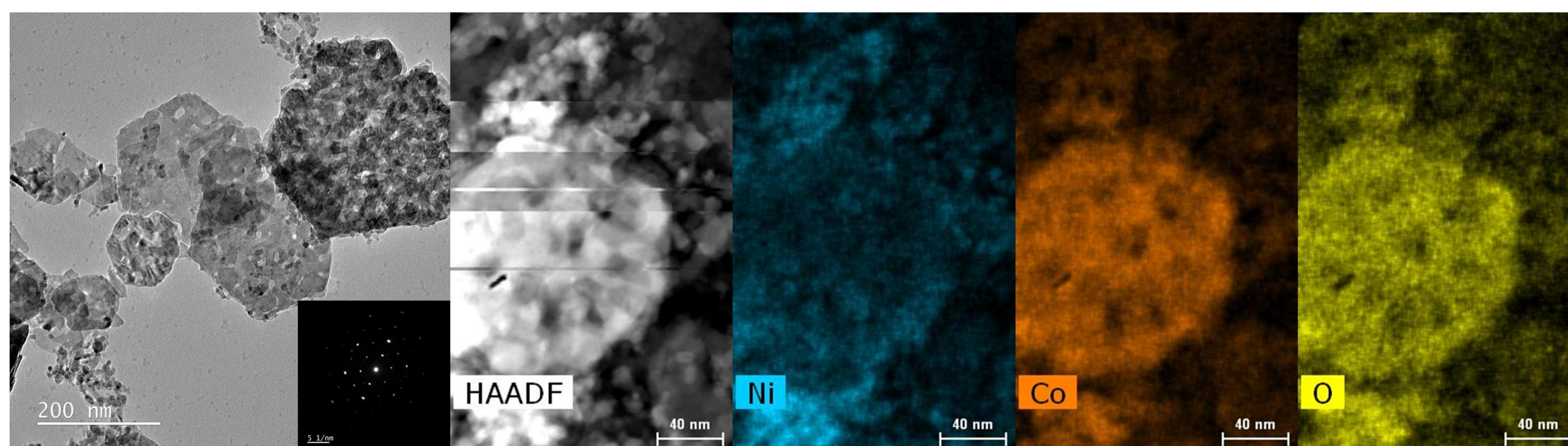
### Synthesis steps



- Picture of stirring setup for  $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  and  $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  in inert environment
- Adding the 2M NaOH
- Washing the co-precipitate with DI water 3x and ethanol once. Filtration was done via centrifugation and decanting the liquid component
- Dried under vacuum overnight



TEM of synthesized  $\text{NiCo}_2\text{O}_4$  powder



## Acknowledgment

This work was supported by the Nebraska Public Power District through the Nebraska Center for Energy Sciences Research at the University of Nebraska-Lincoln