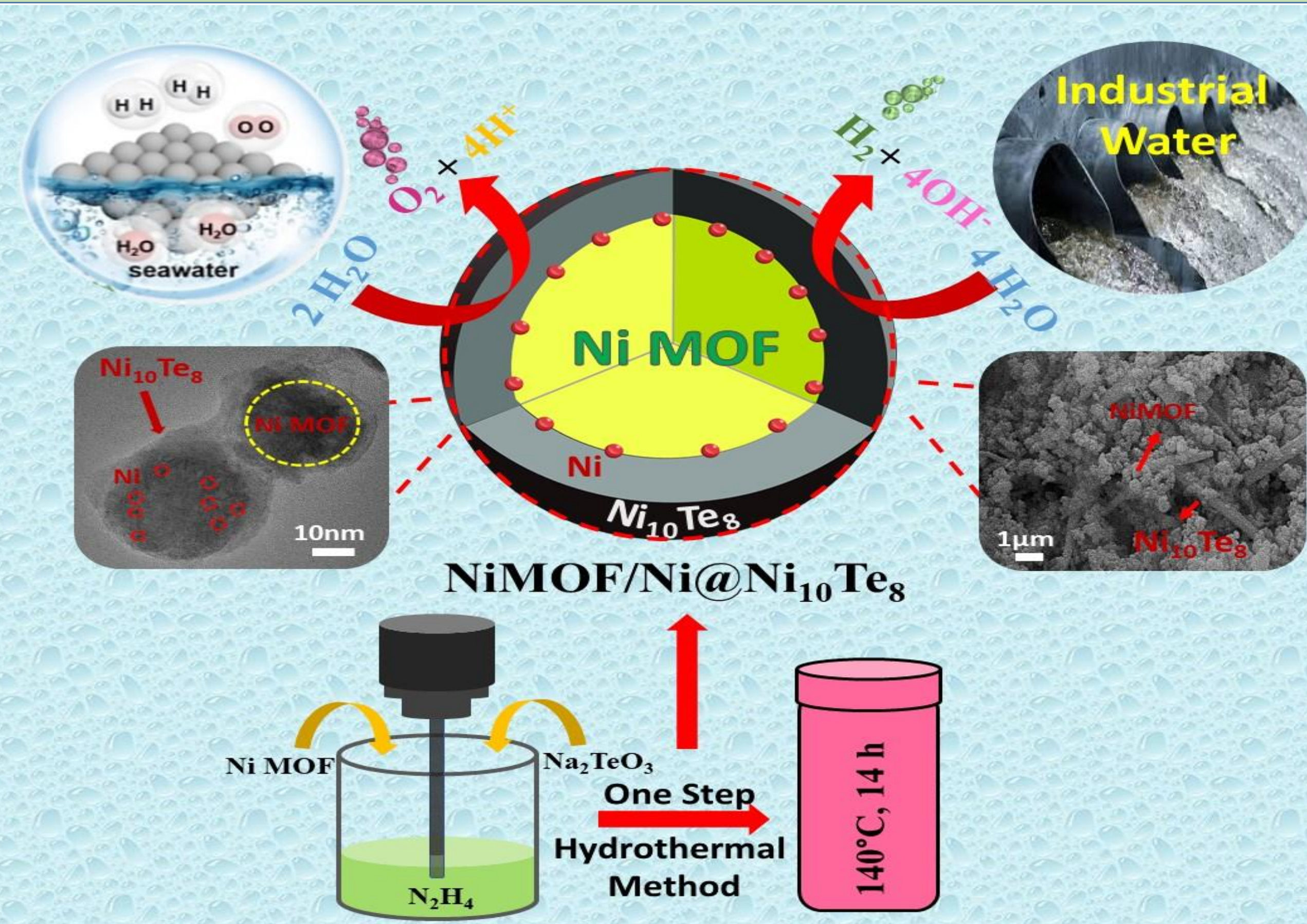


Abstract



Introduction

- Utilizing a facile surface modification technique, a novel core-shell structure is engineered, featuring a MOF core enveloped by a protective NiTe layer with dispersed Ni particles in between.
- The resulting Ni MOF/Ni@Ni10Te8 catalyst demonstrates remarkable efficiency in both hydrogen and oxygen production, excelling in alkaline and seawater environments.
- By utilizing industrial dye wastewater as a resource, this approach achieves dual objectives of wastewater treatment and simultaneous hydrogen production, addressing environmental concerns and promoting environmental sustainability.
- The Ni MOF/Ni@Ni10Te8 catalyst exhibits a low overpotential for both hydrogen evolution (99 mV) and oxygen evolution (180 mV), showcasing its potential for cost-effective water splitting.
- Remarkable Faradaic efficiencies are achieved, with hydrogen production at 95.7% and oxygen production at 92.9%, highlighting the catalyst's effectiveness in clean energy production.
- Harnessing the versatility of MOFs with high specific surface area and synergistic interactions to advance water splitting devices for a cleaner and more sustainable future.

Methodology

- 0.203 g of Ni MOF and 0.15 g of Na_2TeO_3 mixed with 30 ml of DI water and 4 ml of hydrazine hydrate.
- Subjected to probe sonication for 30 minutes, resulting in a uniformly dispersed suspension.
- Suspension transferred to a Teflon autoclave and heated to 140°C for 14 hours.
- Molar ratio of Ni MOF to Na_2TeO_3 maintained at 1:1, labeled as Ni MOF/Ni@Ni₁₀Te₈-1.
- Similar processes used for Ni MOF/Ni@NNi₁₀Te₈-2, Ni MOF/Ni@Ni₁₀Te₈-3, and Ni MOF/Ni@Ni₁₀Te₈-4 with different molar ratios.
- Pure Ni₁₀Te₈ synthesized similarly, using $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ instead of Ni MOF.

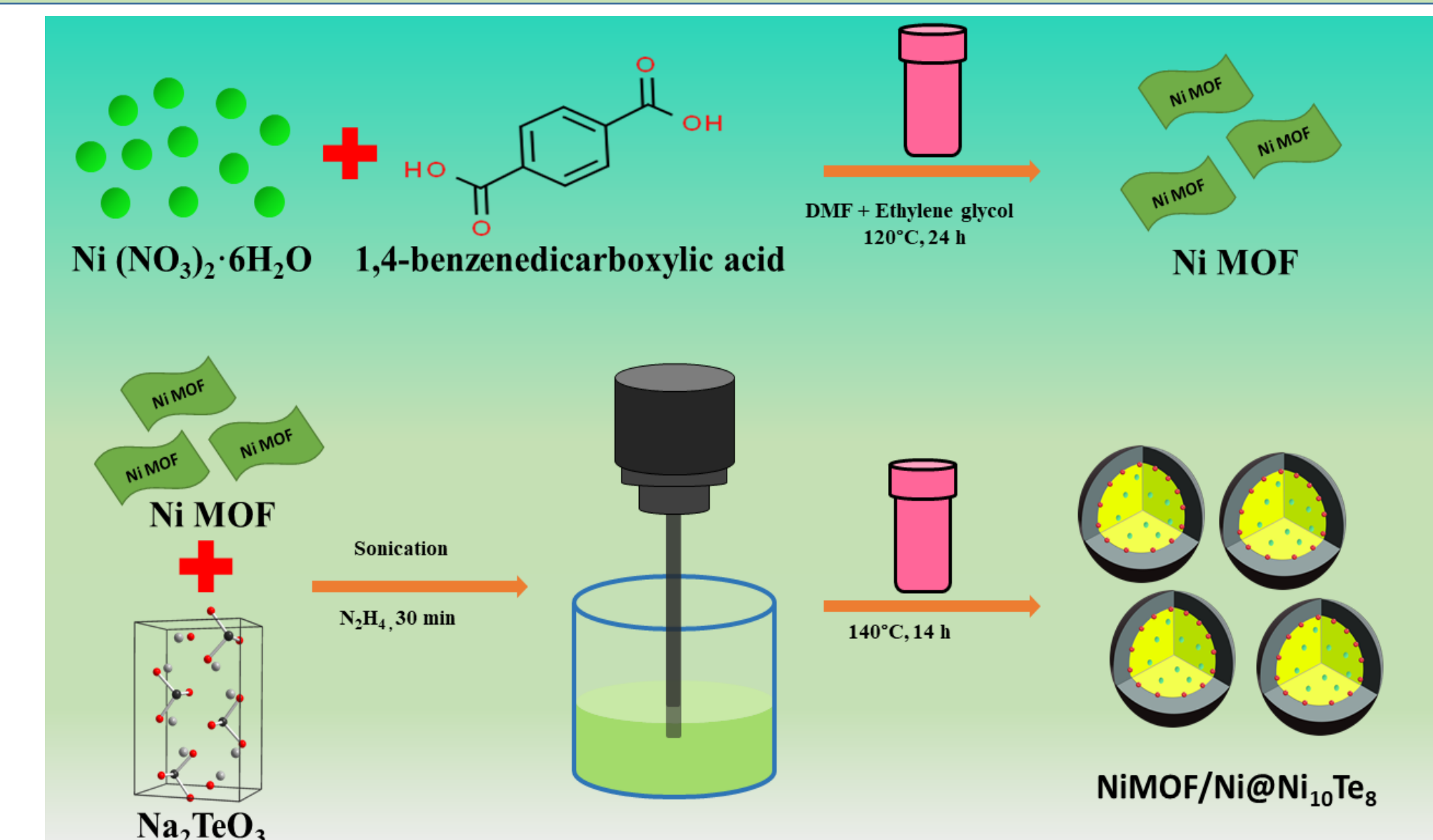


Figure 1. Schematic Illustration for the synthesis of NiMOF and NiMOF/Ni@Ni₁₀Te₈

Characterization

XRD, BET & XPS

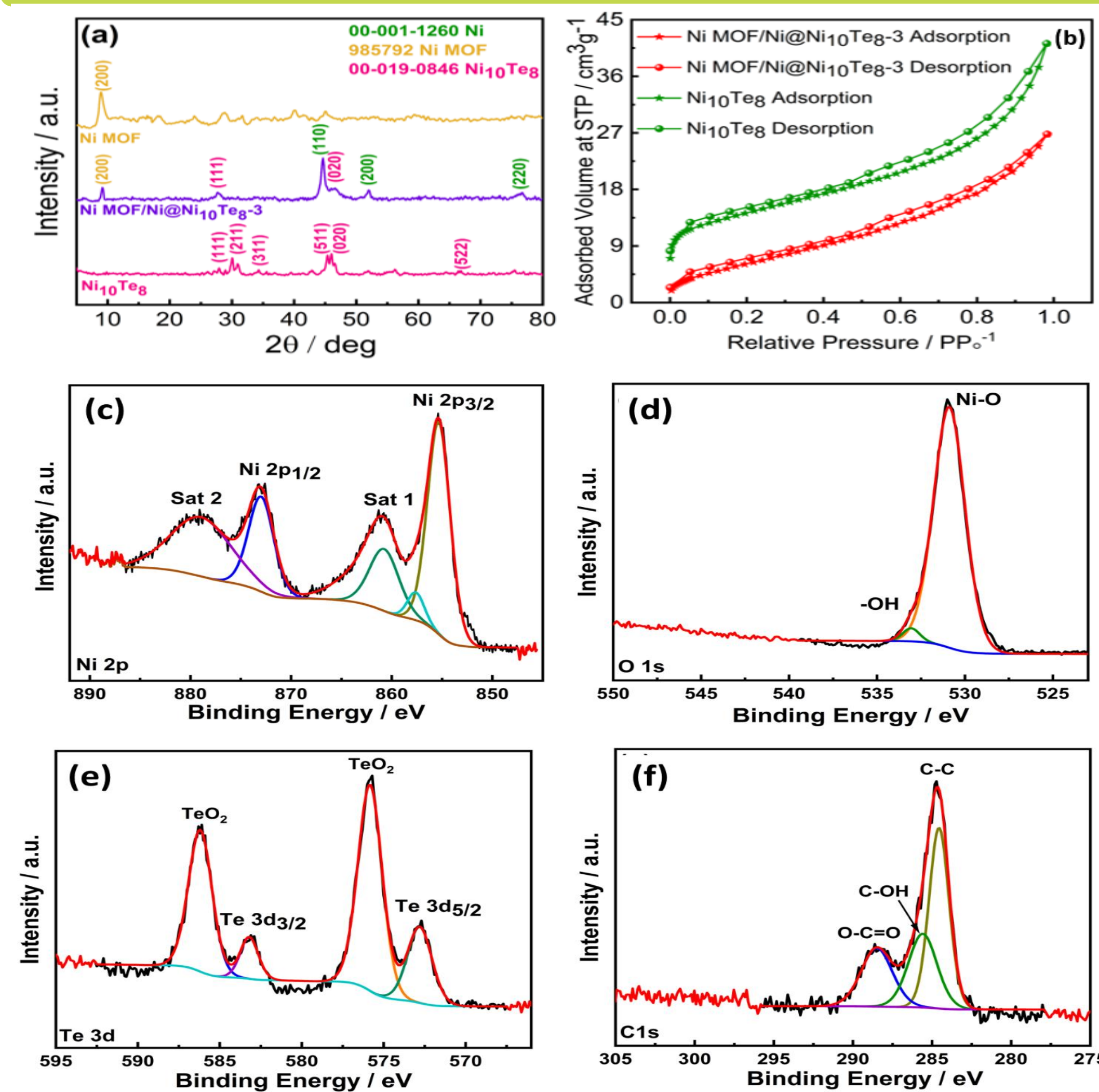


Figure 2. (a) XRD of Ni MOF, Ni₁₀Te₈, Ni MOF/Ni@Ni₁₀Te₈-3, (b) Nitrogen adsorption-desorption isotherms of Ni₁₀Te₈ and Ni MOF/Ni@Ni₁₀Te₈-3, (c) XPS narrow spectrum of Ni2p, (d) XPS deconvoluted spectrum of O1s, (e) XPS narrow spectrum of Te3d, and (f) XPS narrow spectrum of C1s of Ni MOF/Ni@Ni₁₀Te₈-3.

TEM

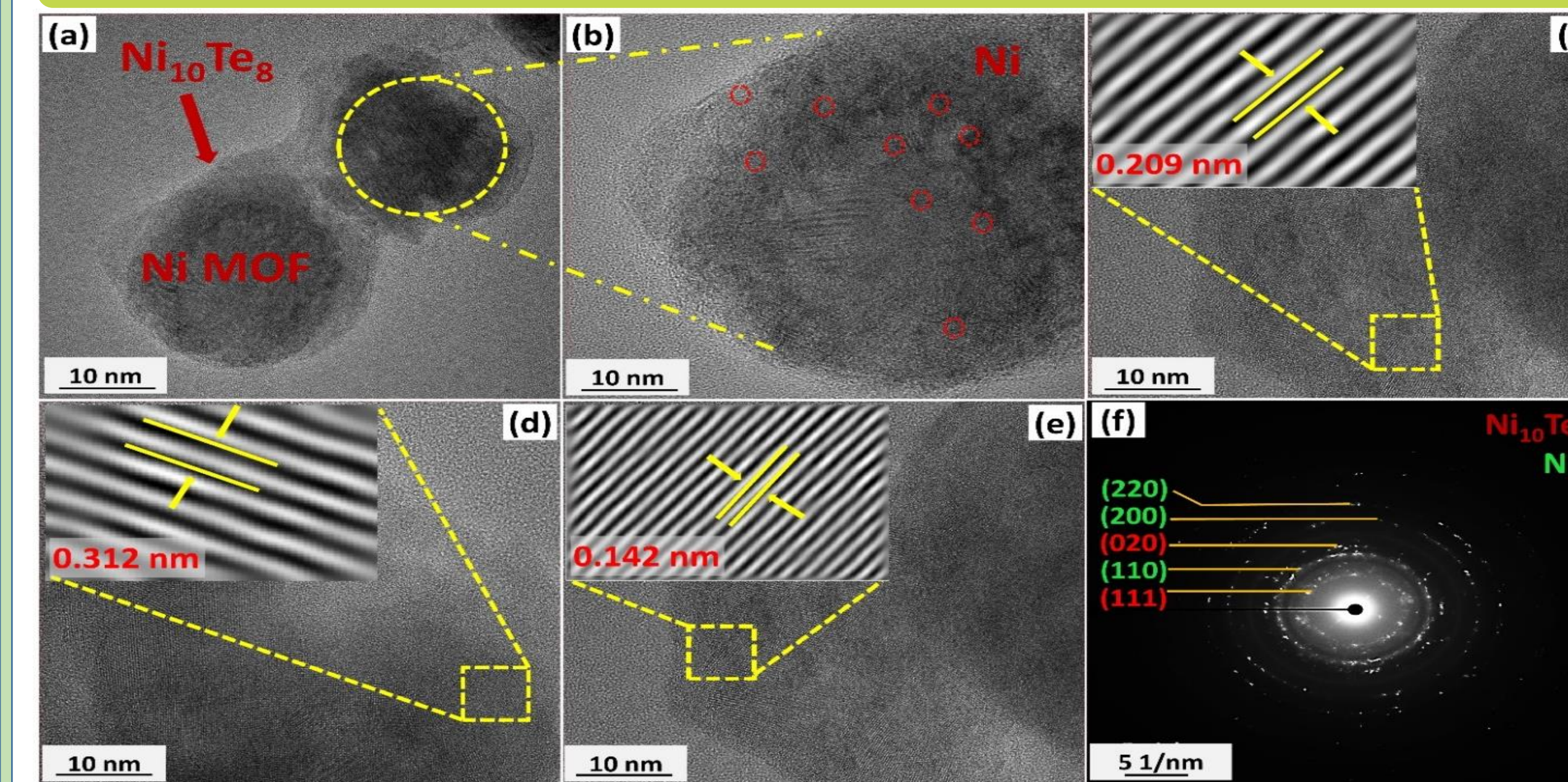


Figure 3. TEM analysis of Ni MOF/Ni@Ni₁₀Te₈-3 at (a-b) 10 nm and different magnifications (c-e) 10 nm with insets showing Inverse FFT image (f) SAED pattern.

SEM

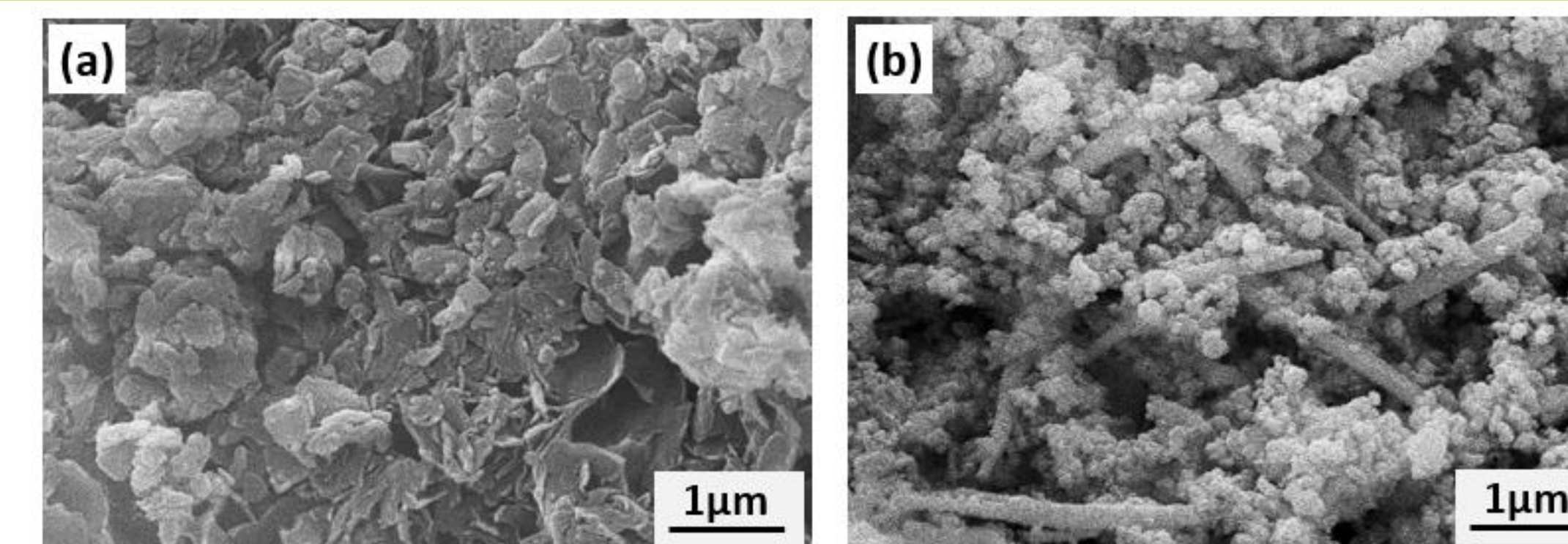
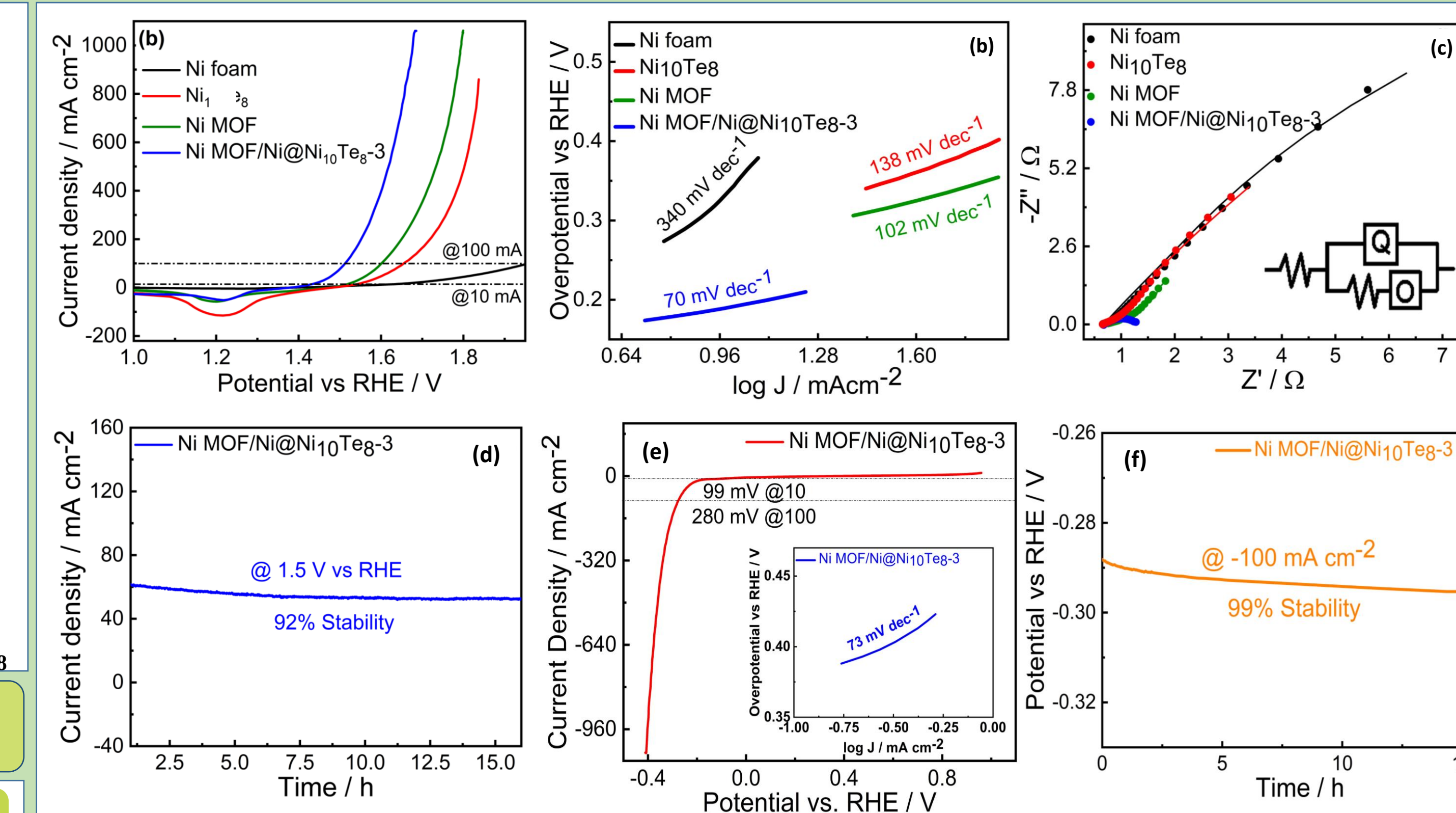
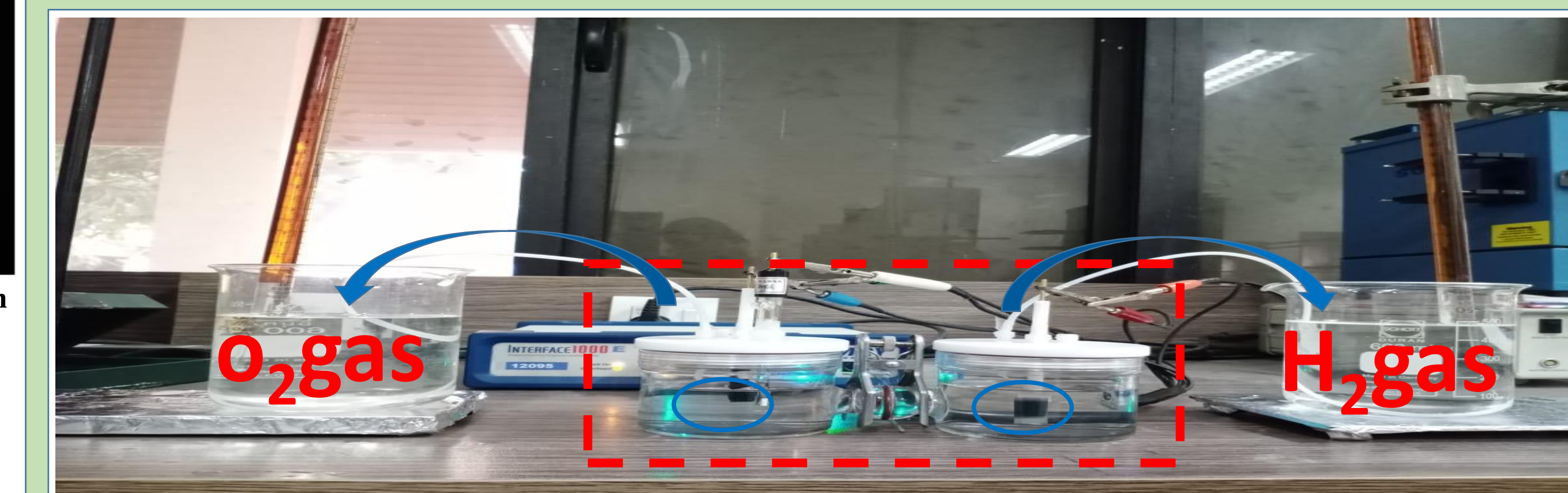


Figure 4. (a) SEM image of pristine Ni MOF at 1 μm, and (b) SEM image of Ni MOF/Ni@Ni₁₀Te₈-3 at 1 μm.

Industrial Water Electrochemical Testing



Collection of H₂ & O₂ Gases



Conclusion & Future Prospects

- MOF/Ni@Ni10Te8-3 catalyst demonstrates exceptional HER and OER performance, indicating high electrochemical efficiency.
- Versatility in different environments and the ability to degrade dyes in wastewater make it a promising solution for environmental challenges.
- Explore its potential for diverse clean energy applications and collaborate with industries for real-world implementation.