



Red TES

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Ultrafast Microwave-Assisted Polyol Synthesis of FeCo Magnetic Nanoparticles for Power-to-Heat Applications

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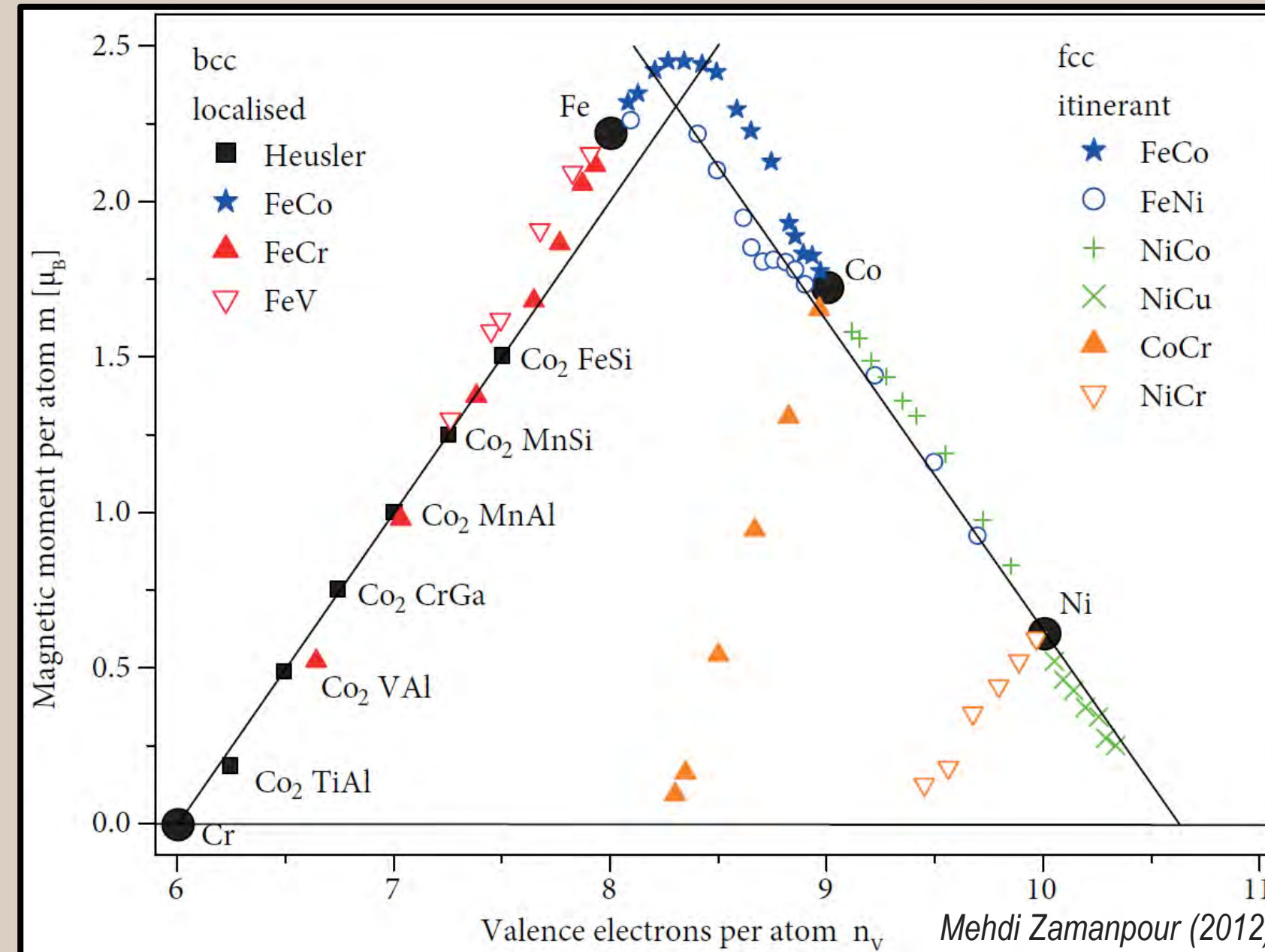
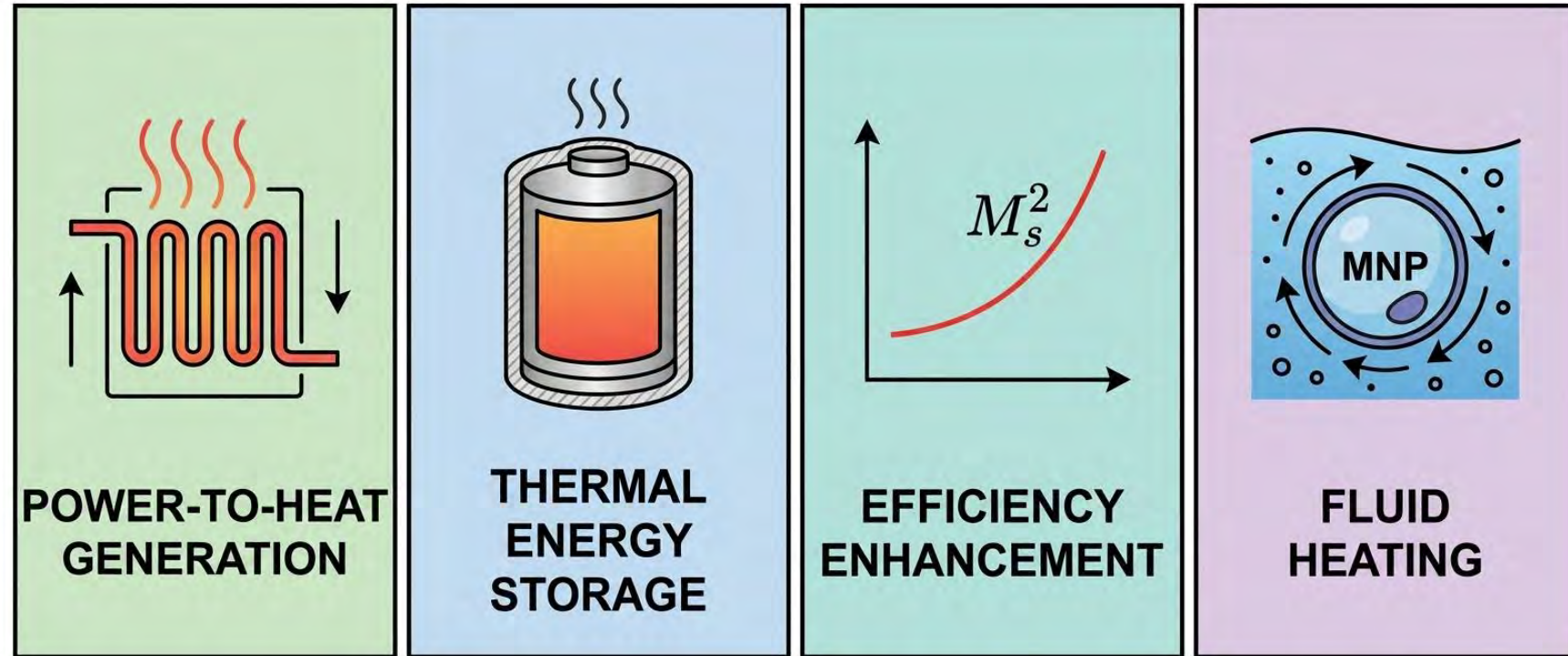


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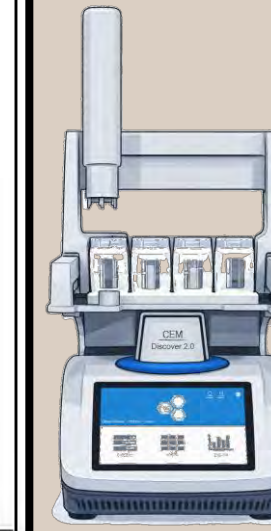
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INTRODUCTION

Magnetic nanofluids (MNFs) have garnered significant attention for their ability to generate heat under alternating magnetic fields (AMF), emerging as key materials for Power-to-Heat and Thermal Energy Storage (TES) applications.



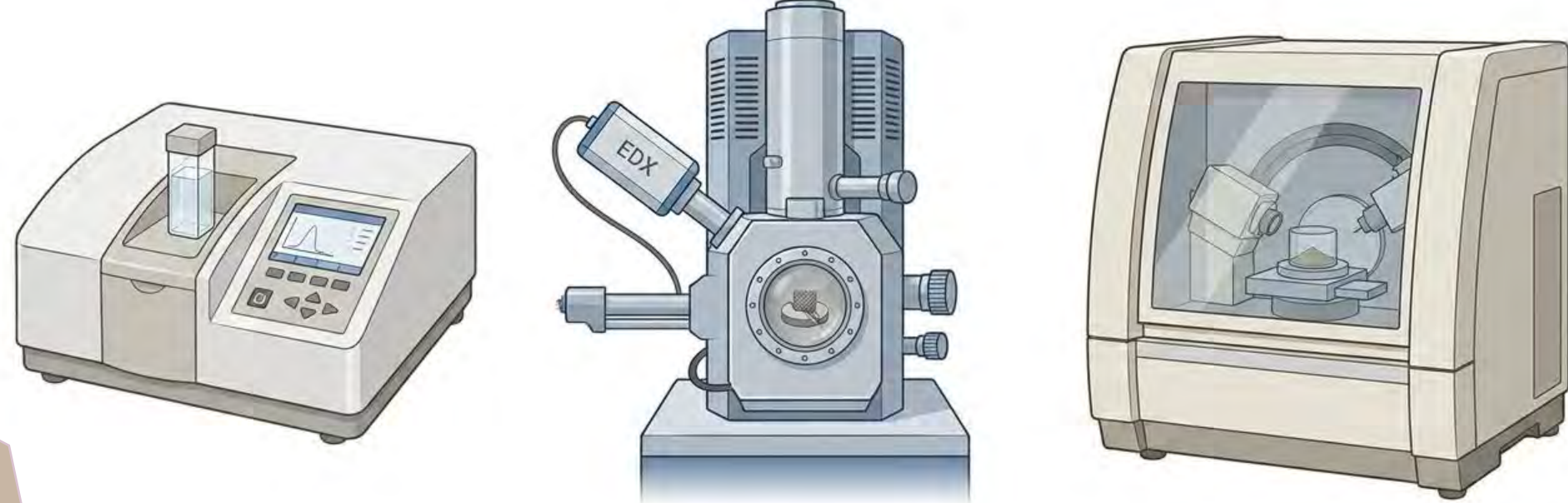
Given that the thermal power delivered to the fluid is proportional to the square of the saturation magnetization, FeCo alloys are exceptionally attractive candidates due to their ultra-high saturation magnetization, which maximizes heating efficiency.



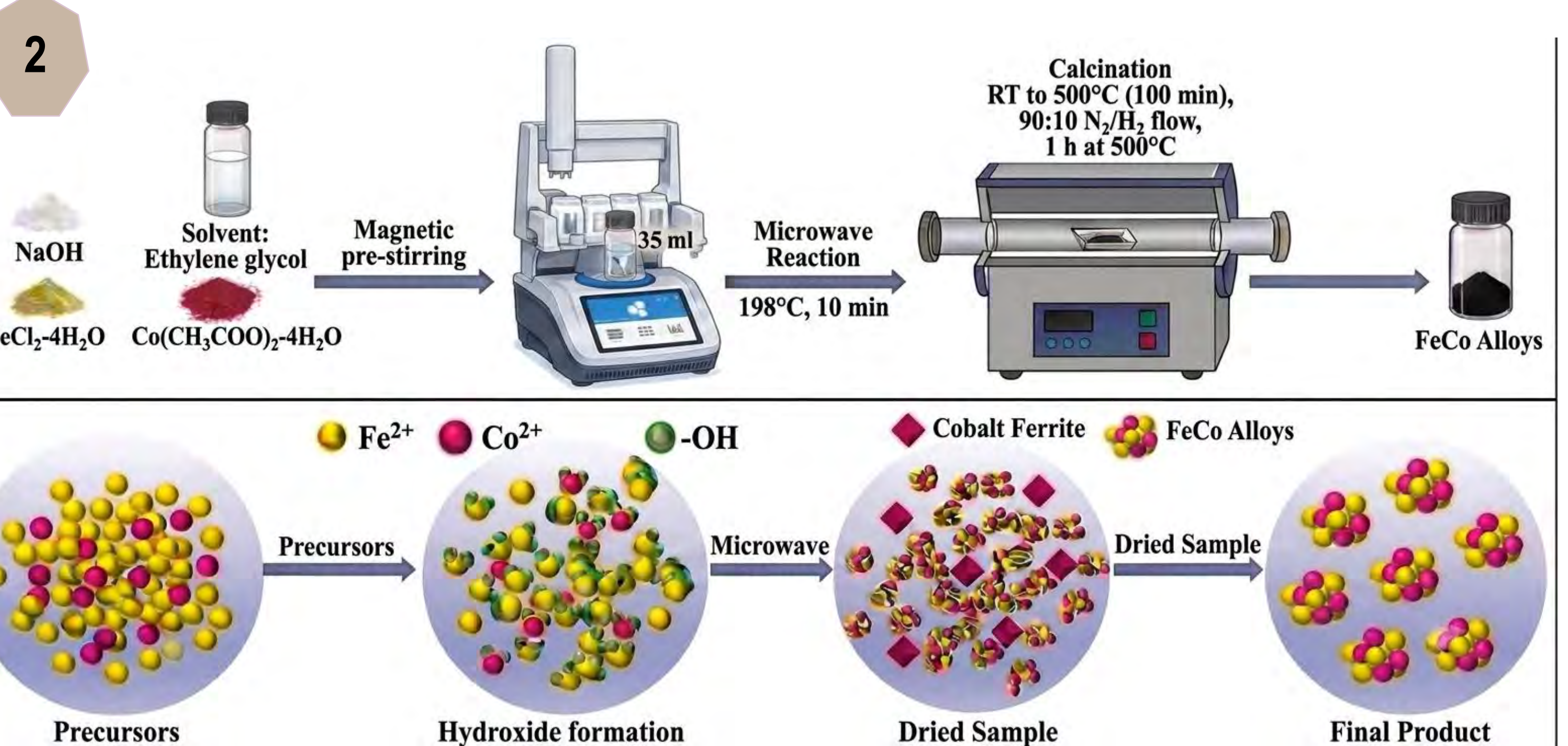
Despite the extensive catalog of synthesis techniques, the microwave-assisted polyol method **REMAINS UNEXPLORED** for producing FeCo nanoparticles. This novel approach uniquely combines the rapid reaction kinetics of microwave heating with the precise morphological control provided by the polyol medium, crucial for optimizing their thermal performance.

METHODOLOGY

1. Precursor Solution: Fe = 0.049 M and Co = 0.021 M (Fe:Co molar ratio of 7:3)
Hydroxide Precipitation: Addition of NaOH in large stoichiometric excess to ensure complete hydroxide formation, maintaining a NaOH:(Fe+Co) molar ratio of 24:1.

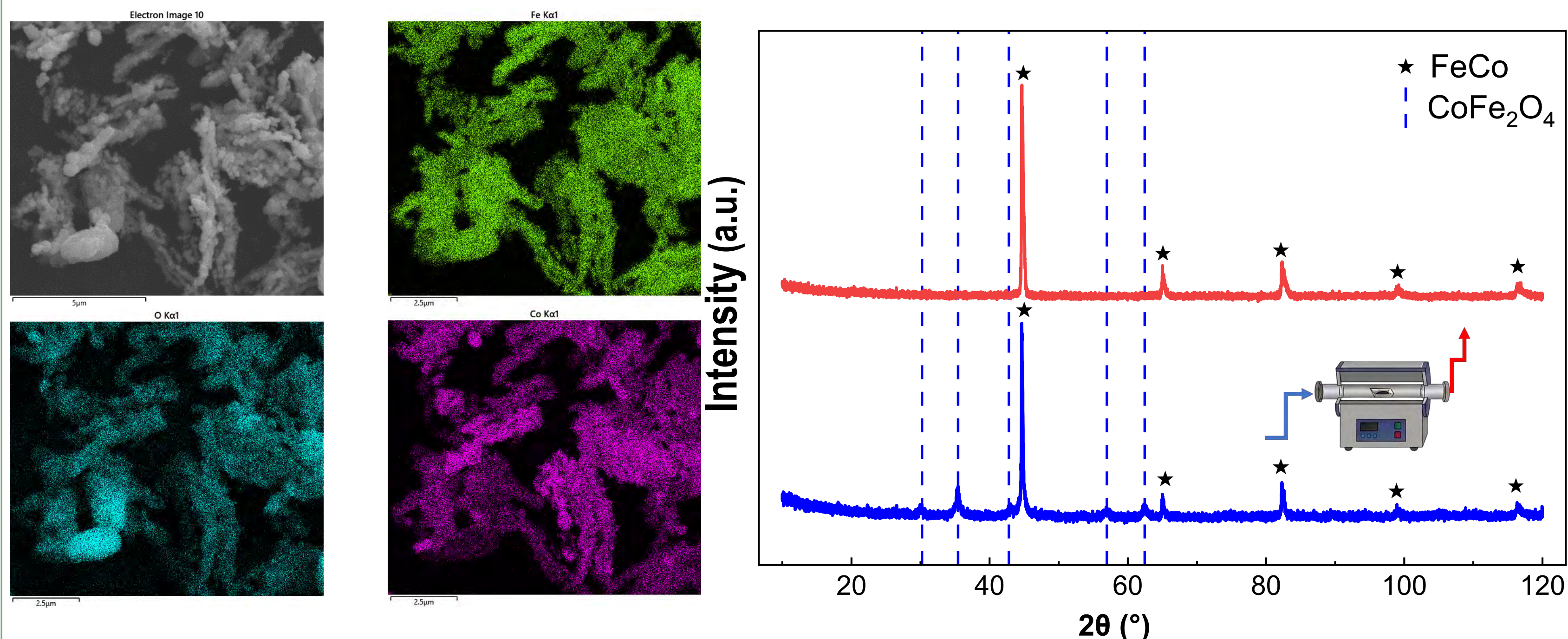


3. LITESIZER DLS 501, DRX DISCOVERY 500, SEM/EDX HITACHI S-4800



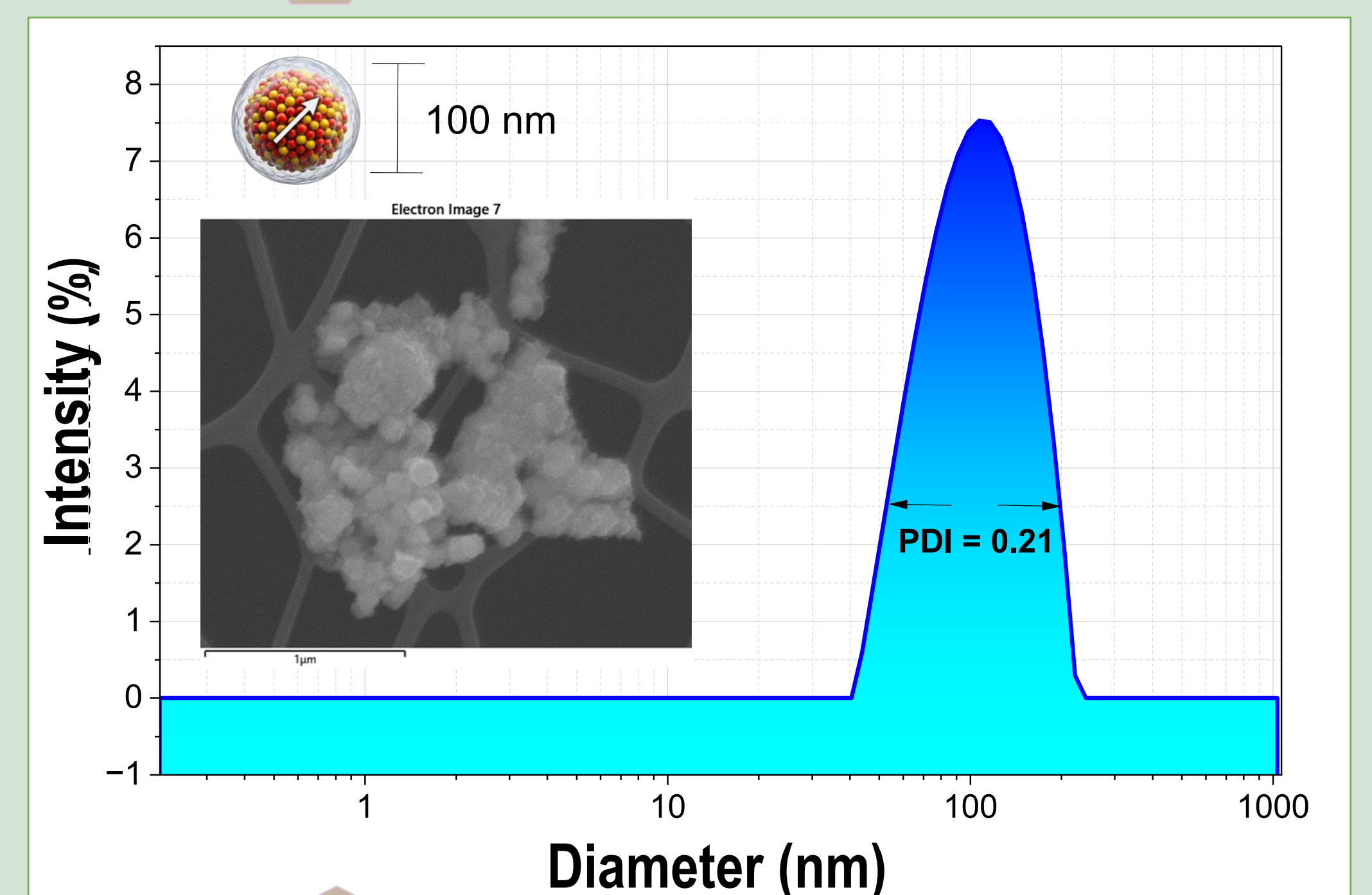
RESULTS AND DISCUSSION

1 Physicochemical & Morphological Characterization

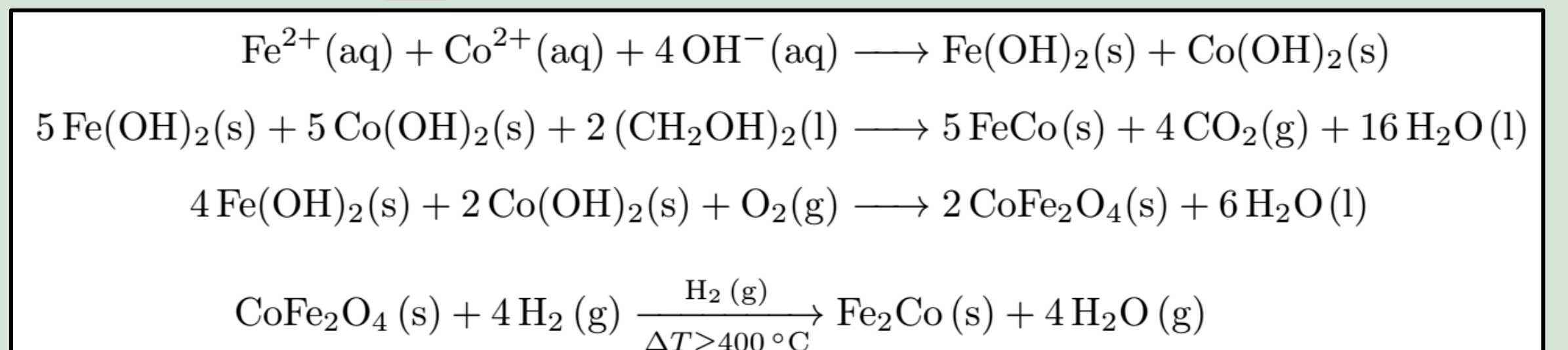


- **Ultrafast Microwave Synthesis:** The metallic FeCo alloy phase was successfully synthesized within just 10 minutes of microwave-assisted polyol reaction, accompanied by trace amounts of cobalt ferrite (CoFe₂O₄).
- **Phase Purification:** Subsequent thermal annealing under a high-temperature H₂ flow successfully reduced the secondary CoFe₂O₄ phase, yielding phase-pure FeCo nanoparticles.
- **Morphology & Particle Size:** Structural analysis confirmed the formation of well-defined nanoparticles with mean particle sizes below 100 nm.

2 Particles size evaluation

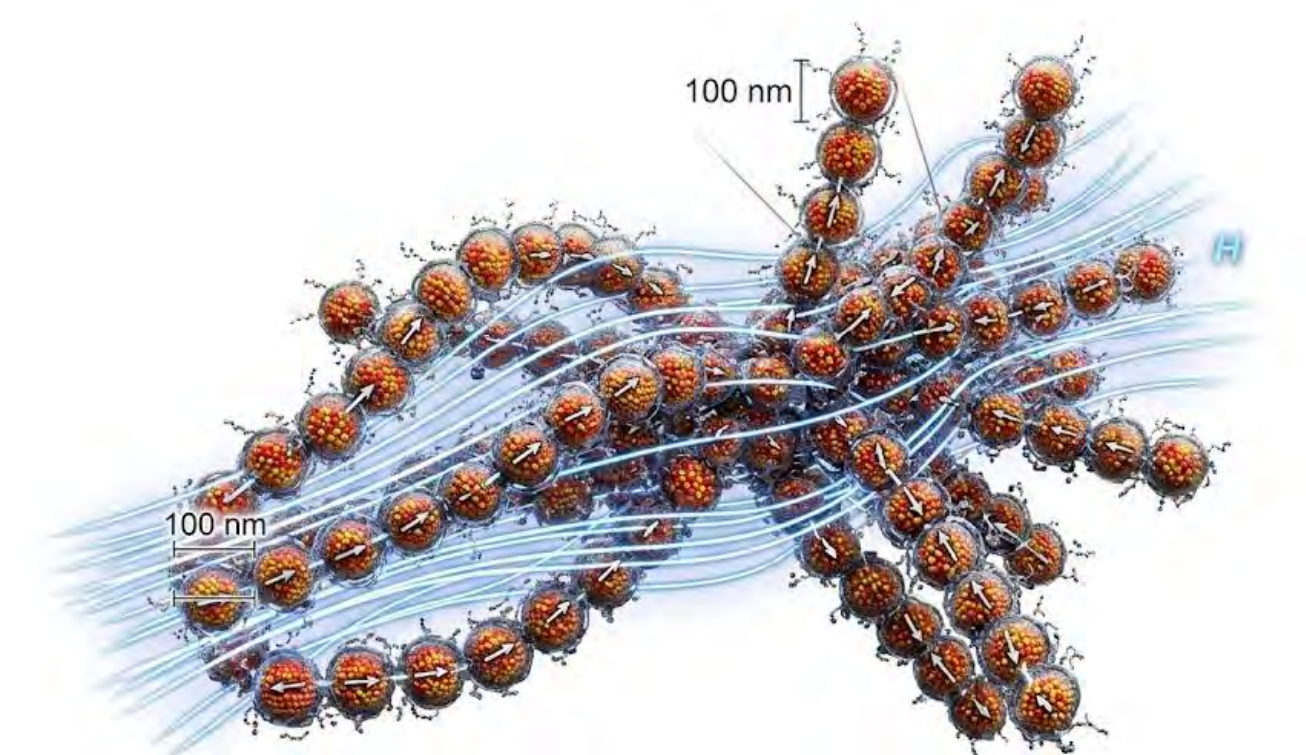


3 Proposed Chemical Equations:



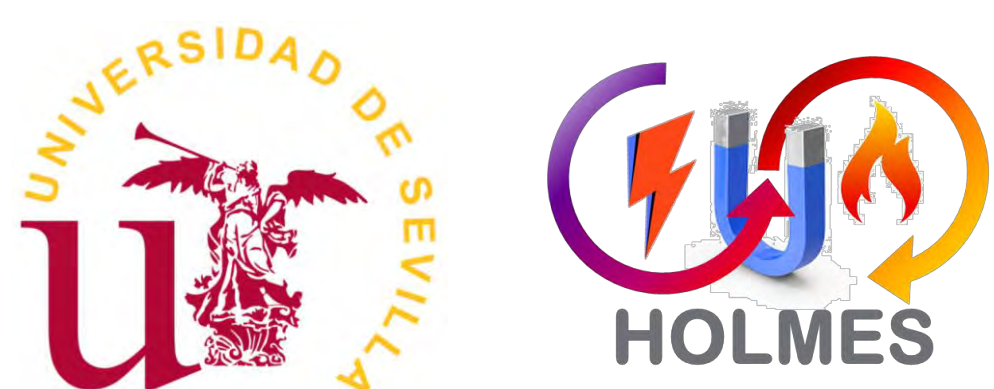
CONCLUSIONS

1. Demonstrates the viability of the first microwave-assisted polyol route as a rapid, energy-efficient method for synthesizing FeCo nanoparticles.
2. Thermal reduction under H₂ flow is established as an effective strategy to achieve high phase purity.
3. Future Work: The primary remaining challenge is designing surface strategies (e.g., core-shell coatings) to prevent particle agglomeration and improve dispersion.



References

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Acknowledgements

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