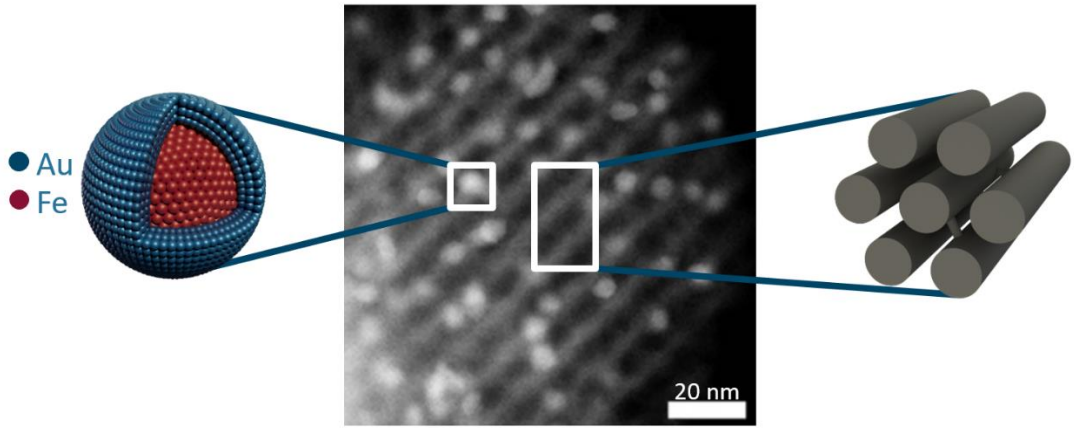
Supported core-shell nanoparticles as electrocatalysts for the nitrogen reduction reaction

The electrocatalytic nitrogen reduction reaction (NRR) is a promising alternative to the energy-intensive and polluting Haber Bosch process for ammonia production. However, the strength of the triple nitrogen bond renders sluggish reaction kinetics and therefore low selectivities, activities and stabilities for current catalysts[1]. To develop an efficient state-of-the art catalyst, synergistic effects between materials must be exploited. Iron and gold show the greatest promise, as single metals, for the promotion of the NRR[1]. The combination, in the form of a core-shell nanoparticle, is predicted to lead to bimetallic enhancements and improved catalytic performance[2] by creating a more electron deficient surface that preferentially binds to N_2 molecules[3]. Incorporation of nanoparticles into an active support, such as nitrogen-doped ordered mesoporous carbon, will further improve the performance. The support has the ability to control the electron density, promoting N_2 binding[4], improve the accessibility of active sites, facilitating diffusion of reactants[5], and limit degradation mechanisms, such as agglomeration[6]. Furthermore, the interface with the metallic nanoparticles will render synergistic effects. Through the combination of state-of-the-art synthesis and advanced electron microscopy, the rational development and optimization of this electrocatalyst can be achieved.



References

[1] Y. Wan, J. Xu, and R. Lv, *Mater. Today*, vol. 27, no. August, pp. 69–90, 2019.

[2] C. Tan *et al.*, *Sci. Rep.*, vol. 7, no. 1, pp. 1–10, 2017.

[3] Y. X. Lin *et al.*, *Nat. Commun.*, vol. 10, no. 1, pp. 1–7, 2019.

[4] S. Su, Y. Shi, Y. Zhou, Y. B. Wang, F. Bin Wang, and X. H. Xia, *Electrochem. commun.*, vol. 107, no. August, p. 106540, 2019.

[5] X. Sheng *et al.*, *Appl. Catal. B Environ.*, vol. 176–177, no. 2015, pp. 212–224, 2015.

[6] V. Beermann, M. E. Holtz, E. Padgett, J. F. De Araujo, D. A. Muller, and P. Strasser, *Energy Environ. Sci.*, vol. 12, no. 8, pp. 2476–2485, 2019.