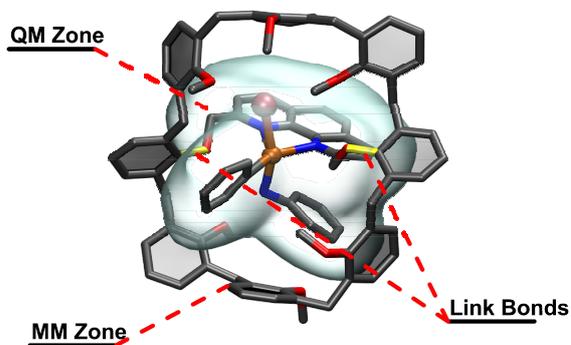


# TACKLING DYNAMICS AND SOLVATION IN TRANSITION-METAL CATALYSIS

Radu A. Talmazan, Maren Podewitz

Institute of Materials Chemistry, TU Wien, Getreidemarkt 9, A-1060 Wien (Austria)



As Quantum Mechanical (QM) methodology evolves alongside computer hardware, larger systems can be tackled in mechanistic studies. This provides a new set of challenges, in the form of correct modelling. Larger systems tend to exhibit markedly higher flexibility, which needs to be taken into account. At the example of a Cu(I)-calix[8]arene supramolecular catalyst for C-N coupling<sup>[1]</sup> we show the importance of accounting for conformer generation, as well as for the solvent environment.

Density Functional Theory (DFT) mechanistic studies are not enough to thoroughly investigate the reaction, with dynamics playing an important role in the formation and release of the product.

To this end, we developed a protocol for obtaining detailed information about the catalytic C-N bond formation in explicit solvent. The combination of DFT and molecular mechanics (MM) with molecular dynamics (MD) simulations in a QM/MM MD type of approach allowed us to investigate the dynamics of the critical reaction steps. Such a strategy requires notable computational resources to fully evaluate the reaction pathway. By replacing DFT with a fast semi-empirical tight binding method, such as GFN2-xTB, we can reduce the computational cost massively, while retaining remarkable accuracy. This in turn allows for considerable sampling of the key reaction steps, allowing for a more complex statistical analysis of the energetics and flexibility of the supramolecular complex.

This strategy opens up a new avenue in the investigation and design of biomimetic supramolecular catalysts.

---

[1] Talmazan, R. A.; Refugio Monroy, J.; del Río-Portilla, F.; Castillo, I.; Podewitz, M. Encapsulation Enhances the Catalytic Activity of C-N Coupling: Reaction Mechanism of a Cu(I)/Calix[8]Arene Supramolecular Catalyst. *ChemCatChem* 2022, 14 (20). <https://doi.org/10.1002/cctc.202200662>.