

# Joint Lecture - UniSysCat & Friedrich Bessel Award Lecture from the Alexander von Humboldt Foundation

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## Small Molecules in Catalysis to Avoid Transition Metals

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Today's major concerns on the industrially used catalytic systems are: i) high expense of catalysts; ii) toxicity of transition metals; iii) difficulties in the removal of trace amounts of toxic-metal residues from the desired product; and finally, iv) the large consumption of heavier and rare transition metals which do not meet the requirement of sustainable development. In this regard, developing environmentally benign catalysts is an ideal alternative. Naturally, the most recent trend in catalyst development heralded a new era using either earth-abundant, nontoxic, inexpensive metals or metal-free catalysis. This talk will discuss our recent developments [1-17] on systematically mimicking the transition metal-based catalysis using small molecules. In this approach, we have used two small molecules: an electron-rich abnormal N-heterocyclic carbene<sup>[1-7]</sup> for discovering new pathways toward CO<sub>2</sub> functionalization and the smallest polycyclic odd alternant hydrocarbon namely phenalenyl (PLY) -based molecules for designing electron transfer catalysis<sup>[8-17]</sup> inspired by an entirely different field of molecular spin electronics<sup>[9,18]</sup>.

References:

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2817-2825.[13] Chemical Science, **2019**, 10, 7433-7441.[14] Chemical Science **2021**, 12, 8353-8361.[15] Chemical Science **2021**, 12, 3039-3049.[16] ACS Catalysis **2022**, 12, 5000-5012.[17] J. Am. Chem. Soc. **2015**, 137, 5955-5960.[18] Nature **2013**, 493, 509-513.

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Organizer