**Single-Atom Catalysts for a New Generation of Industrial Chemical Processes**

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New catalytic processes are urgently needed to drive the transition to a cleaner and more sustainable future, and the European Commission has identified that this is an asset to fulfill the Paris Agreement.

Single-atom catalysts are the new frontier of chemical reaction engineering and can accelerate the shift to a greener future due to their groundbreaking reactivity and ability to economize the amount of critical raw materials.

This lecture will present my groundbreaking contribution in this emerging field, from discovering these new catalysts, to the possibility of studying their reactivity under continuous-flow conditions. Specifically, by focusing on the cycloaddition reactions, which are widely applied in the pharmaceutical sector, I will demonstrate that single-atom catalysts can provide unprecedented activities and selectivities compared to state- of-the-art catalysts. With the help of density functional theory calculations and operando characterization studies, I will elucidate the active sites and propose a plausible reaction mechanism for the flow reaction. Finally, I will demonstrate how the nanomaterials can be nanostructured in flow microreactors to obtain novel structured thin films and foams with integrated single-atom functionalities for intensified chemical processes. This will close the gap on challenges related to catalyst-device integration, going beyond traditional packed- bed and structured reactors, building new bridges between physical chemistry and unit operation.