ABSTRACT:

Mechanochemistry for Advanced Metal-Supported Catalysts: Unlocking New Nanoscale Architectures

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Mechanochemistry—the use of mechanical forces to drive chemical transformations—has ancient origins, but its systematic application in catalysis is relatively recent. In particular, the use of milling for the dry synthesis of metal-supported catalysts remains underexplored, as mechanically induced metal–support interactions are often considered less effective than those obtained via conventional wet methods1. These limitations largely arise from the complexity of milling processes, where multiple interdependent parameters hinder precise control and rational catalyst design. As a result, many studies rely on trial-and-error approaches, leading to inconsistent findings. Here, we present a mild mechanochemical protocol enabling optimal dispersion of palladium on ceria, yielding a unique amorphous coreshell structure with enhanced metal–support interaction and improved catalytic performance2,3. This approach demonstrates the potential of mechanochemistry to access nanoscale architectures unattainable by conventional methods. Through combined in situ and ex situ characterization, we reveal a strong interaction between the support lattice and the metal phase, stabilizing highly reactive species. These features are retained in bimetallic systems. The talk will also highlight the extension of this approach to Cu/CeO_2 and Ru/CeO_2 catalysts for applications in methane activation, ammonia decomposition and CO_2 capture and methanation4,5.

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