Heterogeneous catalysts based on hybrid POSS nanocages for sustainable applications

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Significance and Relevance

The critical need to reduce CO_2 emissions and improve the design of highly recyclable heterogeneous catalysts led us to the development of organic-inorganic hybrid materials from polyhedral oligomeric silsesquioxanes (POSS). In this scenario, we address the application of POSS nanocages as heterogeneous catalysts able to promote CO_2 conversion into cyclic carbonates and C-C cross-coupling reactions, among others. A series of imidazolium-functionalised POSS nanocages was grafted onto silica supports to be used as both organocatalysts and stabilizing supports for palladium-based active species. The proposed materials showed promising catalytic features combined with a wide versatility.

Preferred and 2nd choice for the topic: CO2 utilization and recycling, Green chemistry and biomass transformation, renewable resources conversion
Preferred presentation: Oral preferred or Short Oral

Introduction and Motivations

The design of functional heterogeneous catalysts is part of the transition process toward a more sustainable economy. The huge demand for novel hybrid materials prompted us to focus on the design of modular and efficient synthetic strategies by using imidazolium-modified POSS as building blocks for the preparation of nanocatalysts with tunable applications.[1]

Results and Discussion

Imidazolium-functionalised POSS hybrid molecules were grafted onto silica supports to be used as heterogeneous catalysts for sustainable applications. The proposed materials were prepared *via* a modular synthetic procedure to obtain a high local concentration spots of imidazolium surrounding the POSS nanocage. CO_2 conversion by reaction with epoxides was carried out under solvent- and metal-free reaction conditions showing a full selectivity toward the corresponding cyclic carbonate.[2] On the other hand, imidazolium-modified POSS nanocages grafted onto SiO_2 were used as solid supports for palladium active species in order to catalyse Suzuki-Miyaura, Heck cross-coupling reactions,[3] and the oxidative carbonylation of β-amino alcohols. All the catalysts were fully characterised, easily recycled from the reaction media, and tested with a broad scope of substrates. The synergistic features of the proposed materials can be improved and extended to further catalytic applications. The huge versatility of POSS nanostructures arises from the easy tunability of peripheral organic moieties combined with the high thermal and chemical stability of the inner inorganic core.

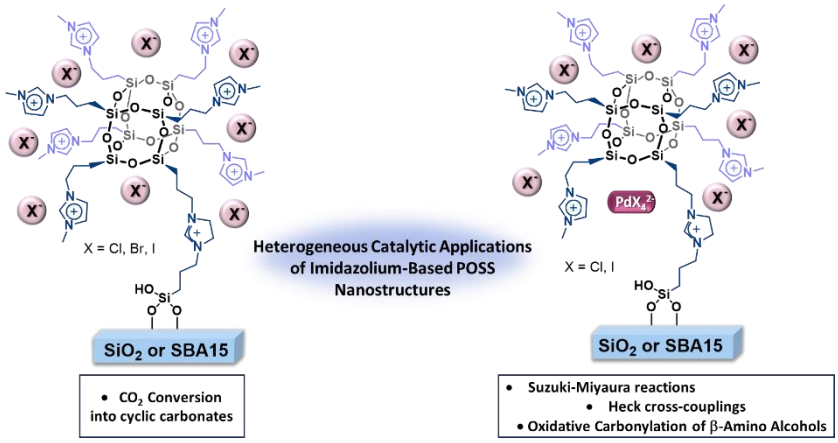

Figure 1 Imidazolium-modified POSS nanocages and their applications in catalysis.

References

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