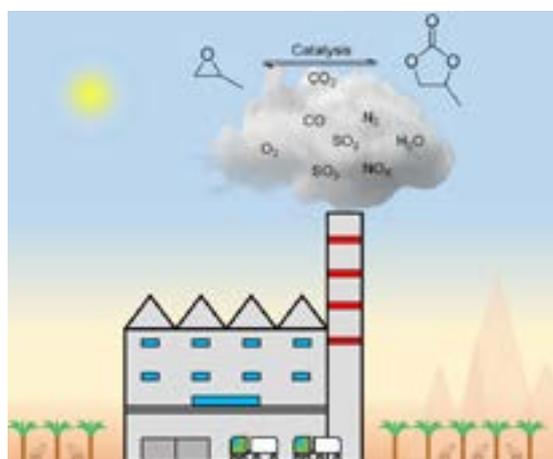


Readily available homogeneous and heterogeneous catalysts for the cycloaddition of CO₂ to epoxides: A low carbon-footprint perspective

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The conversion of CO₂ to chemicals is in the focus of academic and industrial research due to the high demand of viable strategies in alternative to the atmospheric release or geological segregation of carbon dioxide anthropogenic emissions. Cyclic organic carbonates represent a relevant class of chemicals that can be prepared from CO₂ by its cycloaddition to epoxides. Importantly they can be applied as chemical intermediates in the industry, as building blocks for polymers, as solvents and as additives in commercial products. Moreover, they are increasingly studied as useful chemical intermediates. A plethora of homogeneous and heterogeneous catalyst has been developed for the title reaction in the last decades, but, in spite of the exothermic nature of the cycloaddition process, only a small fraction of the published systems are able to promote this reaction under ambient conditions. Among such systems there are very simple halides of early transition metals used in combination with nucleophilic co-catalysts that take advantage of their high Lewis acidity for the step of ring opening of the epoxide substrate. Intriguing mechanistic aspects have been identified that suggest a bimetallic step of CO₂ activation when NbCl₅ is used as a catalyst. This effect has been observed as well for silica supported Nb atoms leading to an unprecedented cooperative effect for surface immobilized atoms in the activation of CO₂. We have recently shown that early transition metal halides of yttrium, scandium and zirconium can also convert CO₂ to cyclic organic carbonates when industrial waste flue gas was used as an impure source of CO₂, an observation that could pave the way for a direct and highly integrated conversion of CO₂ at the point of emission, thus circumventing the additional C-costs relative to purification, compression and transportation of CO₂. These systems will be reviewed along with other recently discovered, readily available catalysts for the title reaction.



Biography

Valerio D' Elia obtained his Master's in Chemistry from University of Perugia in 2001 and worked as a Scientist at Dompe Pharmaceuticals (L' Aquila, Italy). He joined the group of Oliver Reiser (Regensburg, Germany) for his Doctoral Studies in 2005. After a period (2009-2010) at the Ludwig Maximilian University in Munich under Hendrik Zipse, he joined Jean Marie Basset at King Abdullah University of Science and Technology (KAUST) Catalysis Center (Saudi Arabia). Since August 2015, he has been a Faculty Member in the School of Molecular Science and Engineering at the Vidyasirimedhi Institute of Science and Technology (VISTEC) in Rayong, Thailand. His main research interests are CO₂ Chemistry and Catalysis.

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