MgO nanocatalyst for the valorisation of CO_2 in the cycloaddition to epoxides

Cyprien Poucin,[1] Sophie Carenco[1]

[1]*Laboratoire Chimie de la Matière Condensée de Paris, Sorbonne Université, CNRS, Paris, France*

During the past century, the intensification of human activities along with the use of fossil fuels as primary source of energy caused the CO_2 concentration in the atmosphere to drastically increase. Capture, sequestration, and valorisation of this greenhouse gas are of primary importance to achieve the zero net global emissions urged by the Intergovernmental Panel on Climate Change in their last reports.

Magnesium oxide nanoparticles are promising catalysts thanks to the natural affinity of alkaline earth-oxides with CO_2 (due to the presence of both acid and basic site on their surfaces), to the availability of magnesium (one of the most abundant element on earth) and to the low hazard nature of magnesium oxide. By adapting a procedure reported elsewhere [1], we obtained nano-sized MgO, with an average crystallite size of 12 nm, by precipitation of $Mg(NO_3)_2$ salt in basic aqueous conditions followed by calcination at 500 °C. The catalyst was used in the cycloaddition of CO_2 to 2,3-epoxypropylbenzene to form the corresponding cyclic carbonate (4-benzyl-1,3dioxolan-2-one) under 5 bars of CO_2, at 150°C and without solvent. This reaction limits the produced waste: the heterogeneous catalyst can be easily isolated and recycled by thermal treatment, cycloadditions produce a pure product and no solvent is required.

We have here the first blocks of a valorisation pathway for CO_2 respecting the general principles of green chemistry. Optimisation is now necessary to show that this kind of reaction can be economically viable.

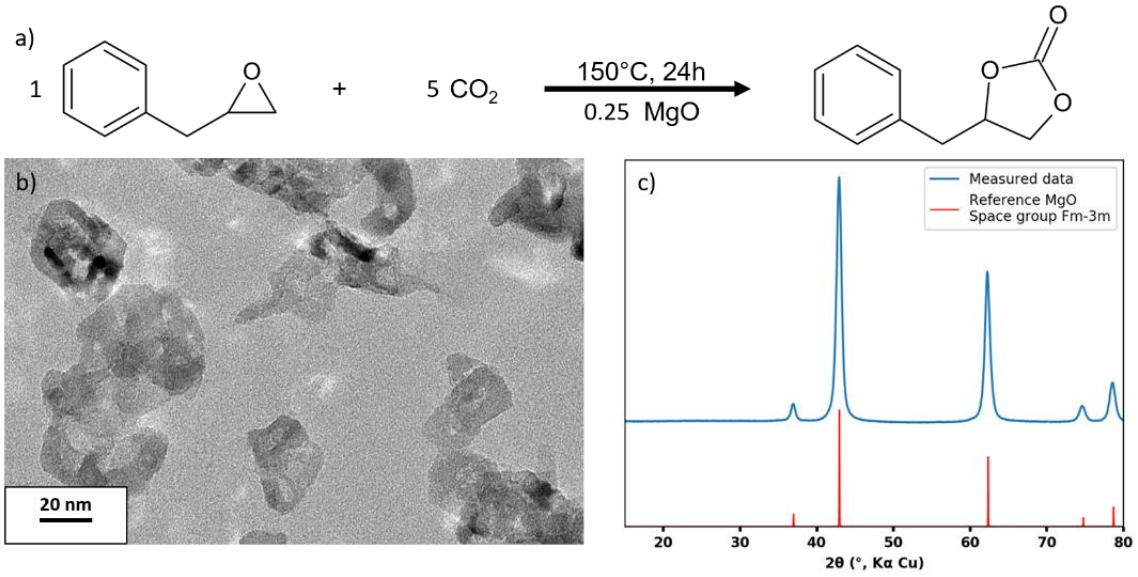

Figure 1: a) Cycloaddition of CO2 on 2,3-epoxypropylbenzene catalysed by nanosized MgO, b) TEM image of the MgO catalyst, c) XRD pattern of the MgO catalyst

[1]. Tu, M. & Davis, R. J. Cycloaddition of CO_2 to epoxides over solid base catalysts. J. Catal. 199, 85–91 (2001)