

Poster GC5

Development of Catalytic Hydrogenation Paths of Carbon Dioxide in Ionic Liquids

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Carbon dioxide emissions are major contributors for the greenhouse effect, this made the scientific community dedicate much of its attention trying to develop methods to reduce its levels in the atmosphere. [1] CCS technologies are being developed, and the use of ionic liquids is an extensively studied subject due to their solubility and non-volatility properties. Soon, CCS technologies will turn available a considerable amount of pressurized liquid CO₂, which should be considered as a resource instead of a waste.

High density CO₂ can be used as a carbon building block for chemical synthesis at high-pressure. In hydrogenation process, CO₂ can be converted into valuable compounds, or preferably into fuels such as methane and/or methanol. [2]

When reducing CO₂ at high-pressures in a biphasic IL/(CO₂+H₂) mixture, CO₂ plays the role of both reactant and carrier. This facilitates the diffusion of reactants into ILs and acts as the carrier gas extracting the products, thus favouring the reaction equilibrium. Screening tests of catalytic hydrogenations with different heterogeneous metallic catalysts were conducted at an initial total pressure of 80bar and a temperature of 140°C for a period of 24h with and without ILs as a solvent. Among Pd, Rh, Ru catalysts, Ru revealed to be the most active catalyst producing methane. Both IL [BMIM][BF₄] and [BMIM][NTf₂] inhibited the reaction; however it was possible to confirm their stability under reaction conditions. Homogeneous reactions at similar reaction conditions were performed. Using the same homogeneous catalyst precursor, [Ru(cod)(2-methylallyl)₂], it was possible to produce different catalytic paths with distinct performances towards selectivity and activity. In the presence of [BMIM][NTf₂] and H₂, Ru(0) nanoparticles were formed. These nanoparticles favoured the production of methane.

Addition of phosphine ligands will compete for the precursor, producing a Ru complex which appears to be more selective towards methanol.

References

- [1] METZ, B., DAVODSON, O., de CONINCK, H., LOOS, M., MEYER, L., Cambridge University Press, International Panel on Climate Change, **2005**
- [2] OLAH, G., *Angew.Chem.Int.Ed.*, Vol.44, **2005**, p.2636