

Department of Chemistry

Green Chemistry in High Pressure CO₂

REQUIMTE / Supercritical Fluids



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<http://www.researcherid.com/rid/B-3620-2010>

<http://www.requimte.pt/index.php?section=271>

Objectives

Atmospheric carbon dioxide is the carbon source of practically all living material on the surface of the Earth. On the other hand, it has become a dangerous pollutant, as the main driver of climate change. The main objective of my research is to devise methods to use carbon dioxide to replace fossil fuel-derived chemicals (i) as a solvent, in reactions, separations, extractions, materials production and other processes used in the chemical, pharmaceutical and food industries: (ii) as a carbon source to produce fuels and valuable chemicals.

Methodology

We use relatively high pressures (usually up to 300 bar) and temperatures just above ambient, in a range of conditions where carbon dioxide is a dense, but highly compressible gas – a supercritical fluid. We use stainless steel vessels, or transparent high pressure sapphire tubes (shown in the pictures). We mix carbon dioxide with solids, liquids and/or gases, either in batch or flow processes. Examples are the recent intensive utilisation of ionic liquids, a new class of liquid chemicals with no vapour pressure, or the development of reactions with hydrogen. We have just started using electrons (electrochemistry) to transform carbon dioxide into fuels.

Expected Results

Sustainable Chemistry requires the use of renewable sources of materials. As Carbon Capture and Sequestration becomes an established industry in the near future, it will produce huge quantities of high pressure carbon dioxide. We expect to continue to contribute to develop methods to use or transform part of those quantities, promoting utilisation over sequestration.

