# Design, implementation and production upscaling of novel, high-performance, cluster-based catalysts for $CO_2$ hydrogenation

## Deliverable D.4.3 - Preliminary

## 1st report on the successful preparation of bi-metal-oxide clusters


| | |
|---|---|
| Grant Agreement No: | 955650 |
| Project start date: | 01.11.2020 |
| Duration of the project: | 48 months |
| Deliverable number | 4.2 |
| Deliverable leader | UU |
| Due date: | 30/04/2023 (M30) |
| Actual submission date: | preliminary report Jan 2024, expected final report May 2024 |
| Dissemination level: | CO |
| Author(s): | Prof. Dr. Sandra Lang (UU) |

## Goal.

The goal of WP4 is to study free 3d metal and metal oxide clusters. While ESR3 focuses on mono- and bimetallic clusters, ESR4 focuses on metal oxide clusters. After the successful production of mono-metallic oxides such as copper, cobalt, and yttrium oxide clusters, ESR3 is supposed to apply the gained knowledge to bimetallic oxide clusters. The focus will thereby be on metallic copper oxides $XCu_xO_y$.

## Approach and Experimental Details.

In deliverables 4.1 and 4.2 we have reported on the successful production of copper oxide clusters with different metal and oxygen content as well as charge state using a laser vaporization source. In the meantime, we also have successfully produced cationic copper oxide clusters with a CORDIS (cold reflex discharge ion source) cluster source. In contrast to the laser vaporization source, the CORDIS cluster source is a continuous source which provides a continuous cluster ion beam. Such a continuous beam is necessary to perform reactivity studies in an ion trap.

To study the influence of a second metal on the metal oxide cluster reactivity and catalytic activity, we aimed to prepare bimetallic copper oxide clusters $XCu_xO_y$ with the CORDIS cluster source. However, due to the breakdown of essential parts of the cluster source and rather long delivery and manufacturing times of the replacement parts, we are somewhat delayed. After successful recommissioning of the cluster source, we first focused on copper oxide clusters. The production of bimetallic oxide clusters is planned for March 2024.