

# Chemical processes use more copper nanoparticles than stars in the sky – but what is their optimal size?

October 5 2016, by Nieske Vergunst

---

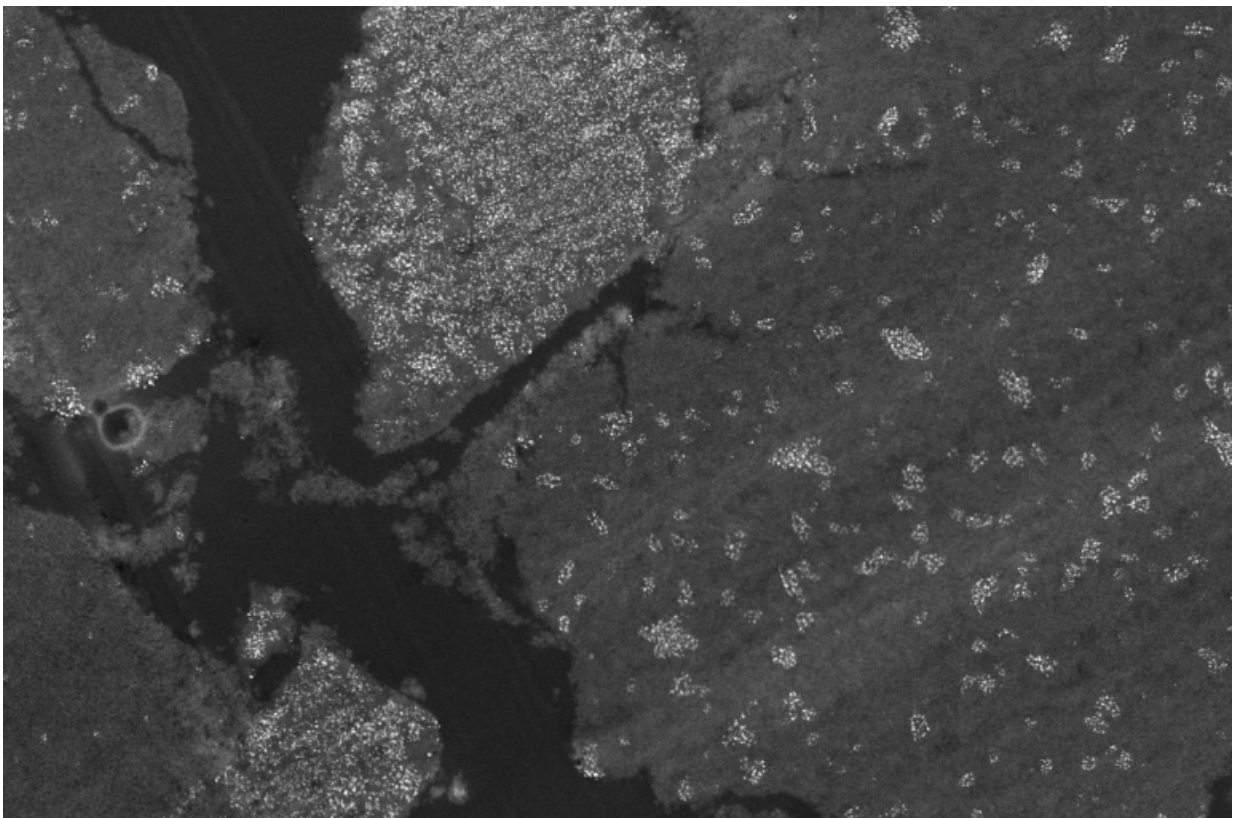


Image of a catalyst – obtained with electron microscopy – in which copper particles of 10 nanometres are visible like stars in the universe. Credit: Utrecht University

Copper particles just a few nanometres in diameter are an extremely important component in catalysts for chemical processes. These processes require immense quantities of these copper nanoparticles – more than the number of stars in the sky. It is thus vital that the raw materials are used as efficiently as possible. So the question for researchers is how big these particles should be in order to function optimally. Researchers at Utrecht University have recently been the first to successfully determine the ideal size experimentally. The results will be published in an article in *Nature Communications* on 5 October.

For decades, scientists have conducted a heated debate about the optimal size of [copper nanoparticles](#). This discussion is important from both a theoretical and a practical perspective. Theoretical calculations predict that the dimensions of the particles would have consequences for the activity of the copper catalysts. However, until now, no one has been able to prove experimentally that this is the case under industrial conditions of high pressure and high temperature. For the first time, researchers at Utrecht University have succeeded in varying the size of particles of copper and copper-zinc from two to 10 nanometres, and to study these particles under conditions of 40 bar and 260 degrees Celsius. In so doing, they discovered that the activity decreased in particles smaller than eight nanometres.

## **Corners, edges and surfaces**

The article's first author, Roy van den Berg, has since earned his Ph.D. and now works in Denmark at one of the largest producers of copper catalysts. "Smaller particles are often more active due to their relatively high density of corners and edges, but we discovered that this is not the case in this instance," he says. "This indicates that it is essential for copper particles to have terraces in addition to corners and edges."

## Methanol production

Van den Berg's supervisors Prof. Krijn de Jong and Prof. Petra de Jongh explain: "From a scientific perspective, this result is very interesting in that it gives us deeper insight into the optimal structure of the catalyst." One use for these copper nanoparticles is the manufacture of methanol, with an annual global production of approximately 65 million tonnes per year, or almost 10 kilos per person per year. "The production of methanol is increasing dramatically, in part because it offers more sustainable routes for the production of building blocks for the chemical industry. Our insights will help in the design of the active and stable catalysts that are needed in this process," according to the supervisors.

**More information:** Structure Sensitivity of Cu and CuZn Catalysts Relevant to Industrial Methanol Synthesis. [DOI: 10.1038/ncomms13057](https://doi.org/10.1038/ncomms13057)

Provided by Utrecht University Faculty of Science

Citation: Chemical processes use more copper nanoparticles than stars in the sky – but what is their optimal size? (2016, October 5) retrieved 26 April 2024 from <https://phys.org/news/2016-10-chemical-copper-nanoparticles-stars-sky.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--