Spray-drying to produce new materials in industrial applications

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Diagram of the different materials that can be obtained with spray-drying. Credit: ICN2

Spray drying is an industrial technique based on the atomization of a solution into aerosol droplets that in turn are evaporated to produce a

powder (dried particles). This technique is well known in the chemical, food, and pharmaceutical industries, where it is routinely used.

At the turn of the century, scientists showed that spray drying could be used to engineer new materials by using each aerosol droplet as a confined microreactor. Building on that work and successive studies, the Supramolecular NanoChemistry and Materials Group at the ICN2, led by ICREA Prof. Daniel Maspoch, has expanded the scope of chemistry accessible in aerosol droplets, including coordination and covalent chemistry. They have also demonstrated that spray drying is a suitable method to produce metal-organic frameworks (MOFs) and covalent organic frameworks (COFs), as well as composites thereof. These results are discussed in *Accounts of Chemical Research*, in an article also signed by Javier Troyano, Ceren Çamur, Luis Garzón-Tovar, Arnau Carné-Sánchez and Inhar Imaz, all from the ICN2 group.

MOFs and COFs are very attractive porous materials due to their broad range of applications, such as gas storage, CO_2 capture or drug delivery. Composites made of MOFs or COFs and other materials are able to boast the strengths and mitigate the weaknesses of each component. However, to facilitate the adoption of these materials, proper fabrication methods must exist. Unlike conventional methods, spray drying enables rapid, continuous and scalable production of dry microspherical powders in a single step. In fact, as part of the project ProDIA, and in collaboration with Prof. David Farrusseng, Axel'One, and the company MOFapps, the group recently demonstrated large-scale spray drying production of the so-called MOFs HKUST-1 and ZIF-8.

The authors anticipate that spray drying will soon be useful to synthesize other types of crystalline porous materials. Nevertheless, they also suggest that MOFs, COFs, and their related composites will require further study. They are optimistic that spray drying processes can still be made greener, safer, cheaper and more amenable to pilot scale.

More information: Javier Troyano et al. Spray-Drying Synthesis of MOFs, COFs, and Related Composites, *Accounts of Chemical Research* (2020). DOI: 10.1021/acs.accounts.0c00133

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