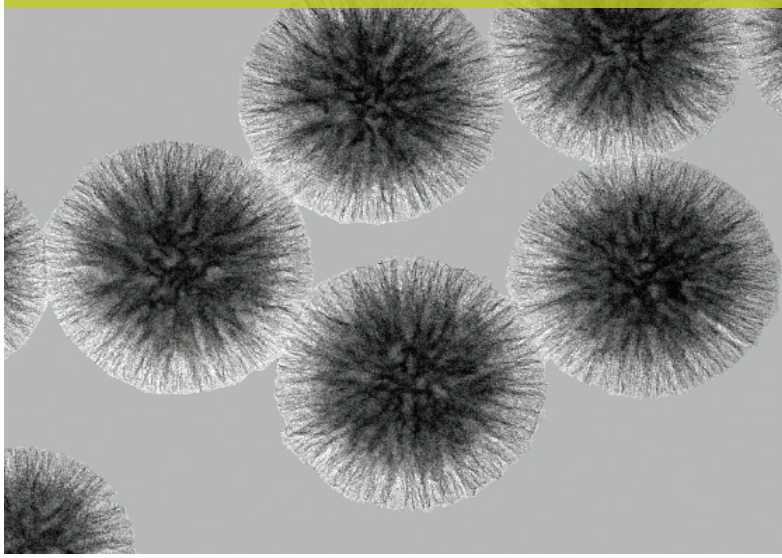
جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

TECHNOLOGY OPPORTUNITY

Fibrous Silica Nanospheres (KCC-1)

This product is ready for material testing and industrial manufacturing



KAUST's novel fibrous silica nanospheres technology (KCC-1) offers exceptional performance in comparison to other types of silica, making it ideal for use in a wide variety of commercial catalysts and sorbent applications. These advances are expected to revolutionize the field of silica-supported catalysts, enabling never-beforepossible applications for silica in catalysis.

KCC-1 has a high surface area due to the tailor-made fibrous and spherical morphology. This has resulted in advanced material properties, such as high mechanical and thermal stability, as well as excellent dispersion in aqueous and nonaqueous media, which further enhance KCC-1's stability as a catalyst support material.

These intrinsic advanced properties have resulted in performance features that have made this material commercially viable in wide range of applications, such as catalyst support and sorbent applications, coatings, petroleum/petrochemical processes, carbon dioxide (CO_2) capture, hydrogen storage, cosmetics, and drug delivery.

Benefits

- **High surface area:** Increased surface area due to the particles' structure and shape
- **High thermal stability:** Up to 800 °C
- **High mechanical stability:** Up to 216 MPa
- **Excellent dispersion**

Applications

- Catalysts supports for many industrial processes
- CO_2 capture
- Hydrogen storage
- Sorbent applications such as in chromatography (column packing)
- Paints
- Cosmetics
- Drug delivery

Opportunity

This technology is part of KAUST's technology commercialization program that seeks to stimulate development and commercial use of KAUST-developed technologies.

Opportunities exist for joint development, patent licensing, or other mutually beneficial relationships.

For More Information

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Technology Details

Our researchers used a hydrothermal synthesis (HTS) process to produce KCC-1. The existence of uniform fibrous channels in KCC-1 renders molecular accessibility to particle surface efficient in comparison to other types of silica and catalyst support materials. Furthermore, the process of making KCC-1 has been successfully optimized, and a pilot scale-up production has reached 1 kg of KCC-1 with 100 percent repeatability. An in-house scale-up facility with a 20-liter reactor has been commissioned to render the chemical process more industrially friendly, as well as test various market applications where KCC-1 can be used as a novel silica material. Now KAUST has the capability of producing 1 kg samples for industry study and testing. We also succeeded in cutting down the cost of production by more than 50% by reducing chemicals and accelerating production times. The table below shows some specifications of KCC-1.

Average particle size	200–400 nm (other particle sizes can be synthesized)
Surface area	>650 m^2/g
Thermal stability	Up to 800 °C
Mechanical stability	Up to 216 MPa
Polydispersity index (PDI)	0.2–0.25
Bulk and tapped density	0.18–0.19 and 0.2 g/cm^3
Viscosity	0.0005 Pas at 25 °C (5% solution)

Why It Is Better

Given the growing need for silica nanospheres, much research has been done to control the shape, structure, and pore size using mesoporous silica. However, the performance, and therefore the applicability, of mesoporous silica has been hindered by the limitation in accessibility to the active sites within the porous structure for many reasons, such as clogging of the pores by the sintering of active metals. KCC-1 offers a unique alternative shape, other than porous, that has never before been seen in silica materials: a fibrous surface morphology arranged in a three-dimensional structure to form spheres. Unlike traditional porebased silica, these nanospheres possess a fibrous structure that dramatically increases accessibility to most of the available surface area. This, in turn, increases catalytic activity significantly.

Tests performed on this technology so far have demonstrated that KCC-1 offered better performance than other silica-based systems (e.g. commercially available SBA-15, MCM-41) in various applications related to catalysis and/or sorption. The KCC-1 production process is under continuous development and improvement to ensure industrial compatibility and widen its commercial applications.

IP Protection

KAUST has an issued patent in US, China, Japan, Europe and GCC for this technology.

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INNOVATION AND ECONOMIC DEVELOPMENT