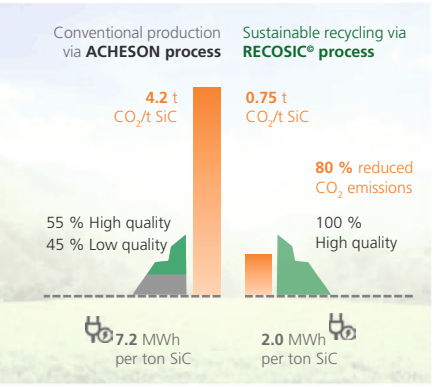
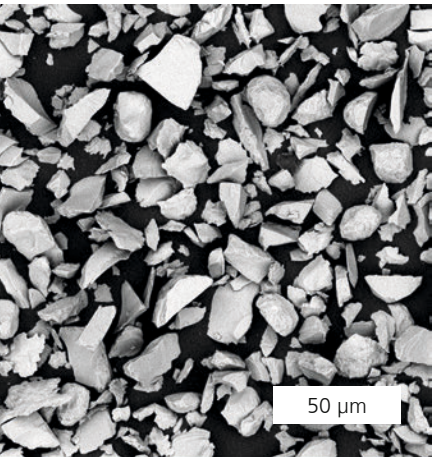
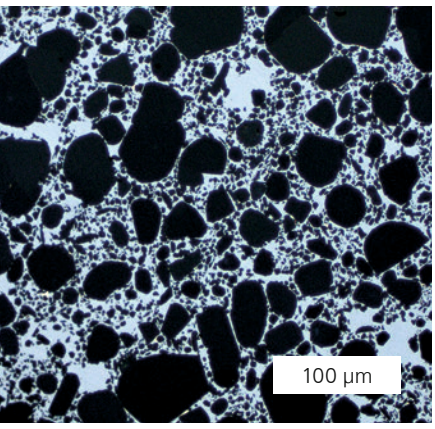


Energy consumption, CO_2 footprint and yield of conventional SiC production (left) compared with the RECOSiC process (right).



Example of a RECOSiC E-ABRASIC F600 abrasive (ESK-SiC GmbH), identical with a conventional abrasive agent.



Microstructure of a SiSiC material made from rounded RECOSiC specialized powder.

RECOSiC – recycling of silicon carbide

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Raw silicon carbide (SiC) has been produced for more than 100 years through the energy-intensive Acheson process – the carbothermal reduction of SiO_2. Global production has reached approx. 1 million metric tons annually. Every ton produced requires approx. 7.15 MWh of electricity and causes approx. 4.2 metric tons in CO_2 emissions. 2.4 tons of these emissions come directly from the reaction, while the remaining 1.8 tons are caused by the production of the required energy (based on the European electricity mix). However, as 70 to 80 % of worldwide production takes place in China, global emissions are even significantly higher than that. Additionally, large quantities of low-grade material accumulate when manufacturing the raw material and refining it to obtain specialized products for the ceramics, refractory and abrasives industries (image 1, left).

This is where a research team of ESK-SiC GmbH and Fraunhofer IKTS came in. They developed and patented the RECOSiC process, which allows to convert low-quality raw materials and byproducts thermally to obtain SiC powder with over 98 % SiC content and a grain size distribution suited to the subsequent target products, with the yield coming close to 100 %. The reusable materials thus obtained subsequently undergo well-established powder treatment processes. After these steps, all material characteristics are identical with, or even improved upon, those of products commonly available on the market (image 2). The RECOSiC process improves the CO_2 footprint of SiC production significantly, with less than one metric ton of CO_2 produced for every recycled ton of SiC. Moreover, the bottom line with regard to raw material consumption is much improved, since the novel process requires almost no primary raw materials (image 1, right). Through sophisticated RECOSiC process management, characteristics, such as grain size and shape, doping and polytype content can be tailored to suit the targeted final product, significantly bettering once again the yield of special products compared with conventional processes. In some cases, it is even possible to achieve properties (such as grain shape) that were hitherto unavailable. For the production of SiC ceramics, this opens up whole new options regarding the optimization of processes and properties, e.g. when it comes to more corrosion-resistant refractory products or additive manufacturing (image 3).

An early RECOSiC test plant, with an annual capacity of a few metric tons, is located at the Fraunhofer IKTS site. ESK-SiC GmbH is currently planning a first processing line with 12,000 tons annual capacity. It is set to make its first steps to becoming fully operational within the first half of 2024. Further development stages are already being planned.

It is expected that in the future waste materials from the SiC ceramics industry (such as green products, sinter scrap) can be introduced into the RECOSiC process as well. Assuming suitable logistics for acquisition, even selected SiC products that have reached their end of life could be introduced into a true circular economy.

Services offered

- Investigations of the recyclability of SiC waste materials
- Optimization of SiC materials for specific applications

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