Photocatalytic purification of problematic waters with TiO_2 components

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Access to clean water is an important issue worldwide. According to the United Nations (UN), more than two billion people have no direct access to safe drinking water. To tackle this problem, the UN has set a specific "Sustainable Development Goal for Clean Water and Sanitation" (SDG 6). The problems arising in connection with water pollution are usually only felt indirectly in developed industrialized countries, especially if these have sufficient water reserves. However, despite the high standard of water and wastewater management infrastructures, persistent trace substances (e.g. pharmaceuticals, pesticides, dyes) enter the water cycle and accumulate there. The processes available on the market have specific technical, economic and ecological disadvantages, so that a new generation of sustainable and versatile, energy- and material-efficient technologies and processes is required, which in turn calls for high-performance materials and systems as well as the associated process design.

3D-printed TiO_2 components

Against this background, Fraunhofer IKTS is developing compact, geometrically functionalized 3D-printed TiO_2 components for the photocatalytic treatment of problematic waters, together with its cooperation partners, Tiger Coatings GmbH & Co KG and Mittweida University of Applied Sciences, as part of the M-Era.Net project "CeramSLS". Organic and inorganic impurities in wastewater are removed by highly reactive radicals, produced under light excitation. Particular attention is therefore being paid to creating a large geometric reaction surface. Furthermore, targeted fluid management aims to increase the retention time in the system and minimize the overall volume of the plant.

Additive manufacturing processes, such as 3D printing, offer enormous potential for the geometric functionalization and miniaturization of components and fast iterations in the development of components, thanks to their high degree of freedom in terms of geometric complexity and their outstanding flexibility in production.

To prove its functionality, the system was tested by eliminating dyes from process waters. The treatment system developed can remove various organic pollutants such as rhodamine B, carbamazepine and diclofenac without leaving any residue, making a significant contribution to sustainable water management.

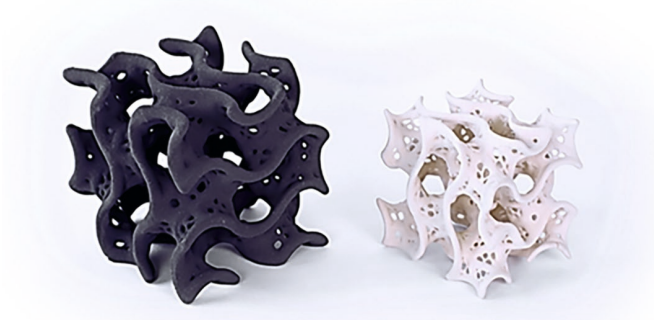

Fig. 1: TiO_2 component before debinding (left) and after low-temperature sintering at 1000 °C (right).

Services offered

- Component development (design and production) based on various AM processes and materials
- Development and characterization of ceramic functional components
- Application-specific process design and prototype development
- Process testing under real conditions, process evaluation

Fig. 2: Water treatment module for the integration of functional components.

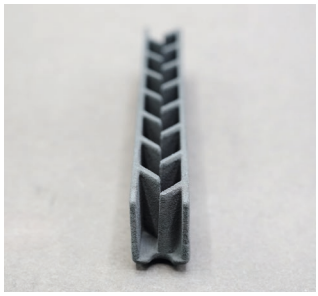

Fig. 3: Functional components, type: fish bone.

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