

Preparation and characterization of porous glass-ceramics in the Na₂O-B₂O₃-TiO₂ system

E. Brade^{1*}, T. Hahn¹, S. Koppka²

¹ Martin-Luther-Universität Halle-Wittenberg, ² Universität Leipzig

*elisa.brade@chemie.uni-halle.de

The preparation of porous glass-ceramics via a subtractive preparation principle is rarely reported, although it opens a pathway to innovative nanoporous ceramic materials. The concept of controlled crystallization is applied to induce crystallization in TiO₂ glasses. An interconnected crystal as well as glassy phase is obtained. Thereby the number of crystals, their growth rate and final size are controlled by a defined heat treatment. [1]

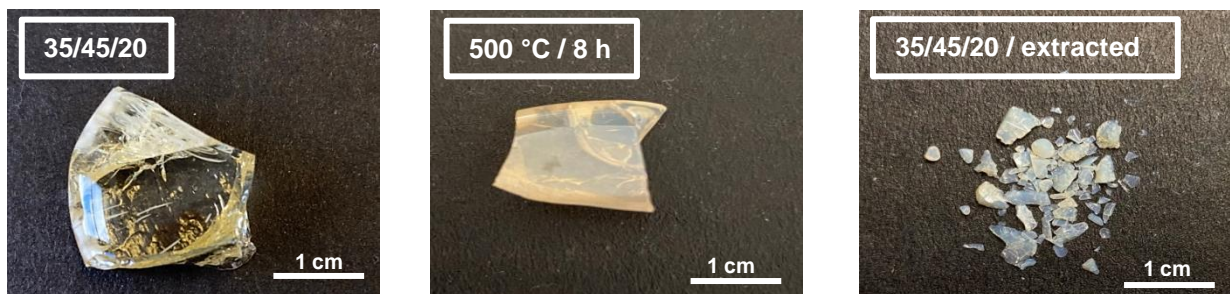


Figure 1: Selected initial TiO₂-glas, TiO₂-glas after temperature treatment and leaching.

Within this study we prepared homogeneous glasses based on the ternary Na₂O-B₂O₃-TiO₂ system, which is firstly described in the studies of Strimple and Giess. [2] Structural and physical properties are investigated within the glassy area.

Through different heat treatment and leaching conditions, TiO₂ glass-ceramics with interconnected structures are produced. It was shown that variation of temperature and duration of heat treatment has an influence to the resulting domains and pore system. Therefore porous TiO₂ glass-ceramics with a BET-surface area between 90 – 317 m²·g⁻¹, a cumulative pore volume V_{cum} up to 0.79 cm³·g⁻¹ and an adjustable pore diameter d_p between 6 – 34 nm can be obtained.

These materials could be applied in the purification of contaminated water and air due to their photocatalytic properties or in hydrogen production by photoelectrochemical water splitting. [3, 4]

References

- [1] Z. Strnad, Glass-Ceramic Materials, Glass Science and Technology 8, Elsevier, **1986**, 9.
- [2] J. H. Strimple, E. A. Giess, *J. Am. Ceram. Soc.*, **41**, **1958**, 231-237.
- [3] K. Nakata, T. Ochiai, T. Murakami, A. Fujishima, *Electrochimica Acta*, **84**, **2012**, 103 – 111.
- [4] A. Fujishima, T. N. Rao, D. A. Tryk, *Journal of Photochemistry and Photobiology C: Photochemistry Reviews*, **1 (1)**, **2000**, 1 – 21.