

Comprehensive characterization of the formation of a glass ceramic upon heat treatment of glass

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Glass ceramics are technologically interesting materials due to their low thermal expansion coefficients, shock resistance and machinability. They can be manufactured in a variety of ways. One of these is via a heat treatment of a glass base material. We have investigated the structural developments during these heat treatments with time resolved SAXS/WAXS and electron microscopy.

The samples had the cordierite composition and were lightly doped with crystallization enhancing Cr^{3+} . A two step heat treatment was applied and the final morphology consisted of around 4% crystalline material in small scattering entities in a further amorphous matrix. Through cross correlations with XAFS and SANS we managed to clarify the role of the Cr^{3+} in this process. By careful control of the temperature it was possible to distinguish between surface and bulk crystallisation and also to characterize the crystallisation kinetics. The morphology predicted on the basis of the X-ray scattering results were subsequently verified by electron microscopy with some unexpected results.