PROJECT "THEORY AND APPLICATIONS OF SINTER-CRYSTALLIZATION" DN 19/7

Glass powder processing, sintering, crystallization, and foaming

Boris Agea-Blanco

Carsten Blaeß[1]

[1] *Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Germany*

carsten.blaess@bam.de

Harald Behrens

Ralf Müller[1]

[1] *Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Germany*

ralf.mueller@bam.de

Abstract:
Glass powders are promising candidates for manufacturing a broad diversity of sintered materials like sintered glass-ceramics, glass matrix composites or glass bonded ceramics with properties and complex shape. Powder processing, however, can substantially affect sinterability, e.g., by promoting surface crystallization. On the other hand, densification can be hindered by gas bubble formation as well. Against this background, we studied sintering and foaming of several silicate glass powders with different crystallization tendency for wet milling and dry milling in air, Ar, N_2, and CO_2 by means of heating microscopy, DTA, Vacuum Hot Extraction (VHE), SEM, IR spectroscopy, XPS, and ToF-SIMS. In any case, foaming activity increased significantly with progressive milling. For moderately milled glass powders, subsequent storage in air could also promote foaming. Contrarily, foaming could be substantially reduced by milling in water and 10 wt% HCl. Although all powder compacts were uniaxially pressed and sintered in air, foaming was significantly affected by different milling atmosphere and was found most pronounced for milling in CO_2 atmosphere. Conformingly, VHE studies revealed that foaming is mainly driven by carbonaceous species, even for powders milled in other gases. Although no clear evidence for stable surface carbonates could be found with XPS and ToF-SIMS, our results indicate that foaming is caused by carbonates mechanically dissolved beneath the surface or encapsulated in cracks and micropores of particle agglomerates.