Degassing phenomena during sintering and crystallization of glass powders

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Background

Degassing may cause trouble in manufacture of sintered glass-ceramics via the formation of bubbles (deteriorate mechanical strength or surface quality).

Experimental

Alkali-silicate-glass powders (D ≈ 1 mm and 30 µm) were studied by MS-analysis of evolved gases at 1E-3 mbar during heating (40 K/min), and by DTA and dilatometry.

Results

Complex degassing behaviour is caused by various mechanism (Fig.1). Examples are (see paper for more detail):

- **b** *Diffusive gas transport* from the bulk (gas release is more pronounced and may be even almost fully exhausted at low temperature for fine powders).
- **d** *Sintering* strongly decreases degassing (diffusion length).
- **e** Primary *crystallization* causes a sharp degassing peak (structural changes can promote transport of volatiles).
- **f** Secondary *crystallization* causes a gas release peak for coarse powders (degassing of fine powders is already exhausted).
- **g** *Melting* of crystalline phases can decrease water release (may be due to a lower water solubility in the former crystal volume fraction).
- **h** Bursting *bubbles* accelerate degassing after melting of the crystal phases (if gases are still soluted in the melt).

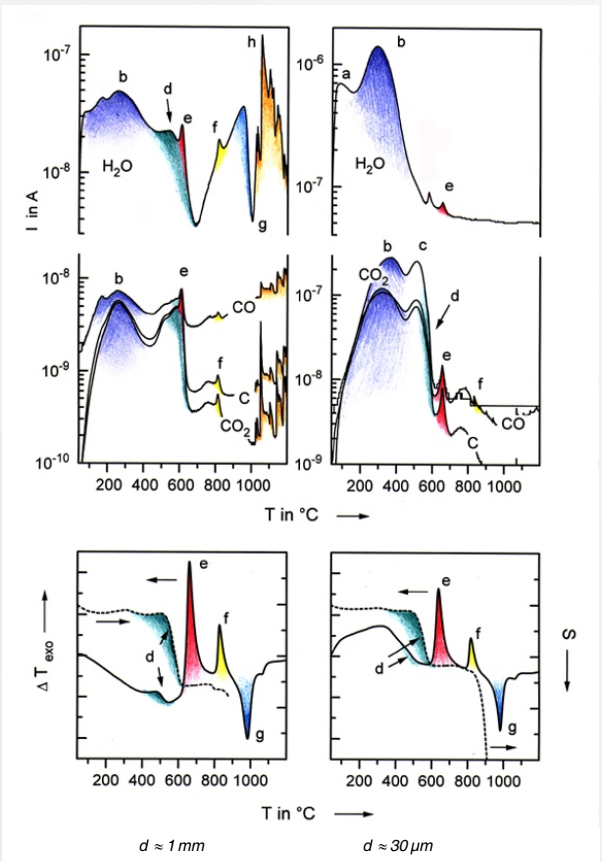

Fig. 1
Top: Dynamic degassing for coarse (left) and fine (right) glass powder (upper curve H_2O; middle CO_2, CO, C). Bottom: DTA curves (left ordinates) and linear shrinkage (right ordinates) in arb. units.

Summery

Degassing of crystallizing glass powders is sensitive to various phenomena (bulk diffusion, sintering, crystallization, melting). Evolved gas analysis backed up by DTA and shrinkage measurements is a powerful tool for optimizing sinterability of glass powders.

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