Oxynitride glass-ceramic microstructures

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Oxynitride glass-ceramics attract an interest, not only because of their improved mechanical properties and refractoriness compared with oxide glass-ceramics, but also because of their presence as an intergranular microstructure in liquid phase sintered silicon nitride based ceramics. This intergranular microstructure is a result of the oxynitride liquid phase sintering medium required for densification. A tailored starting powder composition containing a combination of metal oxide and nitride additives that would form an oxynitride glass-ceramic may result in a liquid phase sintering medium that is readily crystallized after densification leaving a minimum of residual glass.

This presentation will focus on B-phase, which is a five-component phase, and its incorporation into the intergranular regions of silicon nitride ceramics. B-phase glass-ceramics may be fabricated through the nucleation and crystallization heat treatment of nitrogen rich parent sialon glasses with composition (e/o) 35R:45Si:20Al:83O:17N, where R = Er, Yb, Y or a mixture of Y and Yb. The element R determines the degree of crystallization, and it has been shown that a virtually fully crystalline, single-phase, glass-ceramic may be obtained with R = Y.

References

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Water diffusion in trachyte and phonolite melts

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Knowledge on water diffusivity in silicate melts is required for modelling degassing of magmas and magma/fluid interaction. Water diffusion in trachytic and phonolitic melts was investigated in a piston cylinder apparatus at pressure from 5 to 25 kbar, at 1300°C and for durations of 0 to 300 s. As starting materials we have used synthetic analogues of potassium-rich trachyte from the Phlegrean Fields, Italy and potassium-rich phonolite from Laacher See, Germany. Hydrous glasses were produced by fusion of glass powder plus water for 20 h in AuPd capsules in an internally heated pressure vessel at 1200°C and 4 kbar. In diffusion couple experiments two cylindrical halves with different water contents (nominally dry to 5.5 wt%) were combined. Water concentration profiles were measured by Fourier transform infrared microspectroscopy using the peak heights of combination bands of OH and H_2O in the near-infrared. The obtained total water profiles are asymmetric, very steep in the half with low water content but more extended into the water-rich half. Water diffusion coefficients were calculated from the total water profiles by the Boltzmann-Matano analysis and/or numerical fitting. In case of phonolite melts fitting of the profiles indicate that the water diffusivity is proportional to the total water content.

In a first experiment at 1325°C, 15 kbar for 5 min combining phonolitic halves containing 0 and 5 wt% H_2O we determined a water diffusivity of 7.7 10^{-11} m^2/s at 1 wt% H_2O, similar as found by Freda *et al.* [1] for trachytic melts at 10 kbar, but about 0.7 log units faster than in rhyolite (Zhang and Behrens 2000, [2]). Effects of pressure and temperature on water diffusion are discussed.

References

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