Thermodynamic modelling and Raman spectroscopy of silicate melts

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The silicate binary melts of $33\%M_2O{\cdot}67\%SiO_2$ composition, where M = K, Na, Li were studied by high-temperature Raman spectroscopy. The equilibrium between species Q^n can be represented as a disproportionation reaction:

$$2Q^3 = Q^2 + Q^4 \quad (1)$$

From the received Raman spectra abundance of structural units and equilibrium constant of this reaction at various temperatures were determined. Moreover, the distribution of Q^n - species was estimated as a function of temperature and composition using the quasi-crystalline approach to the thermodynamic model of associated solutions [1]. The equilibrium of the reaction (1) shifts to the right with increasing temperature in sodium and potassium silicate melts. Q^n-distribution of lithium silicate melts behaves oppositely, but it is not so sensitive to temperature.

The silicate glasses and melts of ternary system were studied too. By means of Raman spectroscopy it was shown, that there are structural units $Q^3 \leftrightarrow Q^2$ in glasses $(40\text{-}x)\%K_2O{\cdot}x\%Li_2O{\cdot}60\%SiO_2$ and the distribution of modifier cations between these species is not statistical. This distribution can be represented by the exchange reaction:

$$Q^3(K) + Q^2(Li) = Q^2(K) + Q^3(Li) \quad (2)$$

where $Q^n(K)$, $Q^n(Li)$ – structural units, coordinated by cations $K^+ \leftrightarrow Li^+$. By means thermodynamic modelling it was shown that equilibrium of the reaction (2) shifts to the right and the distribution of modifier cations between Q^n - species becomes more random with increasing temperature. According to the idea about acid-base interaction in melts there is ordering of this distribution with decreasing temperature. Such behavior is described by thermodynamic model and is agreed with results of Raman spectroscopy.

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[1] Shakhmatkin B.A. *et al*. // *Int. Cong. Glass,* 2001, 1, p. 52-60.

Determination of the ^{10}Be half-life by HI-ERD and Liquid Scintillation Counting

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^{10}Be is after ^{14}C one of the most frequently used isotope in AMS. That is because of its wide applications in rather different fields of science; but with focus on geo- and cosmo-sciences. However it is also of interest in non AMS related fields like the use as a radioactive clock for cosmic ray studies. All of these demand an accurate half-life of ^{10}Be. There have been several determinations of the half-life in the past and they show a scatter between very roughly 1.3 and 1.5 x 10^6yr. We aimed for a new measurement because of the rather large quantity of ^{10}Be (around 10^{19} atoms) we got, an accurate determination seemed to be possible. This ^{10}Be has been acquired due to a former plan to produce a macroscopic ^{10}Be beam for nuclear reaction studies; however this idea has been abandoned rather soon. Since a quantitative concentration determination at low masses like $^{10/9}$Be might easily be obscured by mass fractionation while using a mass spectrometer, we considered a different approach. It is known that precise ratios of ^{9}Be and ^{10}Be can be determined via HI-ERD (Heavy Ion Elastic Recoil Detection). Thus we performed a dilution series with well known amounts of ^{9}Be added to a ^{10}Be solution. The different solutions have been dropped on silicon discs to let them dry. The HI-ERD measurements yielded then the different ratios of ^{9}Be/^{10}Be and thus the amount of ^{10}Be in the solution. The activity has been measured by LSC (**L**iquid **Sc**intillation **C**ounting). All the measurements have been performed within a short time window to avoid any loss or change of material. The ^{10}Be amount of the solution has then been combined with the results of their activity to calculate a ^{10}Be half-life of 1.39My with an analytical error of roughly 1%. This new half-life agrees with that determined at the University Hannover by ICP-Mass spectrometry (Chmeleff *et al*. this meeting).