07. MATERIALS SCIENCE

07.1-7 INFLUENCE OF UNI- AND DIVALENT CATIONS ON GERMANIUM DIOXIDE FORMATION IN HYDROTHERMAL SYSTEMS. Kosova, T.B., Demianets, L.N. Institute of Crystallography, Acad. Sci. USSR, Moscow, USSR.

At room temperatures GeO₂ may exist in three polymorphs. Two modifications (tetragonal stable and hexagonal metastable) can be obtained under hydrothermal conditions. The limitation of T-range of GeO₂(hex) crystal growth is determined by kinetics of transition GeO₂(hex)→GeO₂(tet) in the presence of aqueous solutions. Besides, the stability of germanium dioxide substantially depends on cation composition and pH of hydrothermal medium.

The use of solvents causes substitution of GeO₂ by germanates. Thermodynamic analysis of GeO₂ stability of both modifications in the presence of uni- and divalent cations at T 25, 200, 300°C has been made. Preliminary thermodynamic properties of germanates, necessary for calculations, were evaluated. One can see (Fig.1) that in the presence of alkaline cations, GeO₂ stability field reduces with the increase of ionic radius of alkaline cations (Li, Na, K). The introduction of divalent cations leads to the further shift of GeO₂ stability limits towards the field of more acid solutions.

The obtained results are confirmed by experimental data. Thus, the crystal growth of GeO₂(hex) under hydrothermal conditions is possible in weak alkaline and acid solutions on quartz seeds. The stable germanates of alkali metals of different composition have been obtained in strong alkaline solutions.

Fig.1: Phase equilibria in the systems GeO₂-H₂O and GeO₂-Me₂O - MeO at 200°C (a) and 25, 200, 300°C (b).

07.1-8 CRYSTALLIZATION OF SODIUM RARE EARTH SILICATE AND GERMANATE CRYSTALS FROM FLUX. By V.A. Pimofeeva and A.B. Bykov, Institute of Crystallography of the USSR Academy of Sciences, Leninsky pr. 59, Moscow 117333, USSR.

Crystals of sodium rare earth silicates and germanates were first grown under hydrothermal conditions [1]. Some new crystals together with already known ones 0.5–1 cm in size have been grown from flux. The crystallization fields of NaYSiO₄, Na₂YSiO₄₋₁/₄NaF (these crystals have been grown for the first time), Na₃YSi₃O₉, Na₃Y₃Si₄O₁₂, Na₃TRSi₃O₉ (TR=Gd, Y, Lu), Na₃Gd₃GeO₁₂ have been found. The phase equilibria in silicate and germanate flux systems Na₂O - TR₂O₃ - SiO₂(GeO₂) - NaF - V₂O₅ - PbO have both similar and differing features. Therefore, the crystallization field of Na₃TRGeO₄ is the widest in the germanate system while Na₃Gd₃GeO₁₂ has the same particularity in the silicate system. The sodium fluoride does not enter the chemical formula of germanate crystals in contrast to the case of Na₂YSiO₄₋₁/₄NaF.

It should be noted that in our experiments the major attention was paid to the growth of Na₂TRGeO₄ :Nd³⁺ crystals since the preliminary spectral and luminescence investigations [2] raised the possibility of stimulated emission in these crystals. The crystal growth method consists not only in nucleation on a platinum rod and the following growth of crystals by slow cooling of the solution but also in top-seeding growth combined with pulling.

Laser elements in the form of plane parallel plates 2 mm thick were made from the grown crystals measuring up to 1 cm. The results of the spectral and lasing experiments on these specimens allow to suggest that at a suitable geometry of the element continued laser action by pumping of Xe and Kr lamps can be achieved.

REFERENCES