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Influence of Thermal Annealing on Phase Composition and Structure of Quartz-Sericite Minerale

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Abstract : Raw materials with high content of Kalium oxide widely used in ceramic technology for prevention or decreasing of deformation of ceramic goods during drying process and under thermal annealing. Becouse to low melting temperature it is also used to decreasing of the temperature of thermal annealing during fabrication of ceramic goods [1,2]. So called “Porceline or China stones” - quartz-sericite (muscovite) minerals is also can be used for prevention of deformation as the content of Kalium oxide in muscovite is rather high (SiO2, + KAl2[AlSi3O10](OH)2). [3] . To estimation of possibility of use of this mineral for ceramic manufacture, in the presented article the influence of thermal processing on phase and a chemical content of this raw material is investigated. As well as to other ceramic raw materials (kaoline, white burning clays) the basic requirements of the industry to quality of "a porcelain stone» are following: small size of particles, relative high uniformity of disrtribution of components and phase, white color after burning, small content of colorant oxides or chromophores (Fe2O3, FeO, TiO2, etc) [4,5]. In the presented work natural minerale from the Boynaksay deposit (Uzbekistan) is investigated. The samples was mechanically polished for investigation by Scanning Electron Microscope. Powder with size of particle up to 63 μm was used to X-ray diffractometry and chemical analysis. The annealing of samples was performed at 900, 1120, 1350oC during 1 hour. Chemical composition of Boynaksay raw material according to chemical analysis presented in the table 1. For comparison the composition of raw materials from Russia and USA are also presented. In the Boynaksay quartz – sericite the average parity of quartz and sericite makes 55-60 and 30-35 % accordingly. The distribution of quartz and sericite phases in raw material was investigated using electron probe scanning electronic microscope «JEOL» JXA-8800R. In the figure 1 the scanning electron microscope (SEM) micrograps of the surface and the distributions of Al, Si and K atoms in the sample are presented. As it seen small granular, white and dense mineral includes quartz, sericite and small content of impurity minerals. Basically, crystals of quartz have the sizes from 80 up to 500 μm. Between quartz crystals the sericite inclusions having a tablet form with radiant structure are located. The size of sericite crystals is ~ 40-250 μm. Using data on interplanar distance [6,7] and ASTM Powder X-ray Diffraction Data it is shown that natural «a porcelain stone» quartz – sericite consists the quartz SiO2, sericite (muscovite type) KAl2[AlSi3O10](OH)2 and kaolinite Al203SiO22H2O (See Figure 2 and Table 2). As it seen in the figure 3 and table 3a after annealing at 900oC the quartz – sericite contains quartz – SiO2 and muscovite - KAl2[AlSi3O10](OH)2, the peaks related with Kaolinite are absent. After annealing at 1120oC the full disintegration of muscovite and formation of mullite phase Al203 SiO2 is observed (the weak peaks of mullite appears in fig 3b and table 3b). After annealing at 1350oC the samples contains crystal phase of quartz and mullite (figure 3c and table 3c). Well known Mullite gives to ceramics high density, abrasive and chemical stability. Thus the obtained experimental data on formation of various phases during thermal annealing can be used for development of fabrication technology of advanced materials. Conclusion: The influence of thermal annealing in the interval 900-1350oC on phase composition and structure of quartz-sericite minerale is investigated. It is shown that during annealing the phase content of raw material is changed. After annealing at 1350oC the samples contains crystal phase of quartz and mullite (which gives gives to ceramics high density, abrasive and chemical stability).

Keywords : quartz-sericite, kaolinite, mullite, thermal processing
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