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### Investigation of process of quartz glass crystallization by confocal Raman spectroscopy

In our work, industrial type glass for UV (KU-1 quartz glass (QG)), visible (KV QG) and IR (KI QG) regions have been chosen. Sizes of samples are 40x40x5 mm. It's working surface had been polished by CeO<sub>2</sub> and after that heating was performed. In region 1100-1300°C stability of temperature was maintained at ± 2°C. Heating was conducted during 10 hours. Visual observations of working surface has shown growth of crystallization regions (CRs) with typical in-plane dimensions of tens of microns. Nevertheless in-depth dimension can reach about 100 microns. Shapes of CRs varies with type and concentration of impurities that are present in the type of glass. Most different shapes of CRs were observed in KV because of high concentration of impurities and OH bonds comparing to that in other samples. Mostly shapes of CRs in other samples has radial symmetry. It was due to begin of crystallization near impurity metal ion such as Al<sup>3+</sup>, Ca<sup>2+</sup>, Na<sup>+</sup>, Mg<sup>2+</sup>, Mn<sup>2+</sup> or Fe<sup>2+</sup>. This ions substitute Si<sup>4+</sup> in SiO<sub>2</sub> tetrahedra or embedded between them. Investigation of early stages crystallization in industrial type quartz were performed by confocal Raman spectroscopy techniques. By 2D mapping and in-depth confocal measurement it was shown that crystalline region is made up of crystallization center, intermediate layer and thin bound. Intermediate layer is made up of α-SiO<sub>2</sub> quartz nanoparticles with diameter more than 20 nm. According to Raman spectra and our calculations thin bound is made up of α-SiO<sub>2</sub> nanoparticles with diameter 2-8 nm coagulated with Fe<sub>2</sub>O<sub>3</sub>, Fe<sub>3</sub>O<sub>4</sub>, TiO<sub>2</sub> and SiC. Such coagulation enhance multiphonon processes in Raman scattering of crystalline quartz.

### Biography

Dmitrii Pankin has completed his Master's thesis. Currently, he is a PhD student at Saint Petersburg State University on physical faculty.

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