composed of "skeleton" and "filler" phases. Following this approach the variation of the phase ratio was determined as a function of the firing regimes and concentration of the fusing agents. The dependences obtained appear to have a good correlation with the mechanical properties of ceramics.

The results of the present study indicate that the method employed is of advantage for both single crystals and polycrystalline materials.

[1] Yu. M. Smirnov and G. S. Blokhina. Melt supercooling and crystal morphology. In: *Physics of Crystallization* (Kalinin, KSU, 1983), p. 13.
[2] Yu. M. Smirnov and A. M. Ivanov. Classification of clay additives. In: *Physics of Crystallization* (Tver, TSU, 1994), p. 86.

PS12.01.14 PARTICULAR SINGULAR FACES IN SINGLE CRYSTALS. A. I. Kolesnikov and Yu. M. Smirnov, Tver State University, 170000 Tver, Russia

In the course of the investigation of the growth, morphology and structural defects in germanium single crystals we have defined the main morphological features of dislocation-free germanium crystals [1].

The single crystals were grown in the <111> crystallographic direction by the Czochralski method. The crystal-melt interfaces of the crystals grown were flat mirror singular {111} faces (*F*-planes according to the Hartman's conception of PBS vectors). In addition, also observed were narrow stripes of {110} faces on the lateral sides of the crystals (*S*-planes according to the above conception).

On the basis of the study of dislocation-free germanium and silicon single crystals we arrived at a principle of a particular singular face. These faces are singular, but are characterized by the least possible specific surface free energy. For germanium and silicon these are faces with the crystallographic symbol {111}. The free energy of the germanium {111} face is 0.85-1.10 $J \cdot m^{-2}$, while the free energy of the {110} face is 1.30-1.35. $J\ m^{-2}$. For other faces the free energy is considerably higher.

The principle was realized in the development of the growth process of paratellurite (tellurium dioxide) single crystals. As was deduced theoretically, in paratellurite single crystals the face of minimum specific free energy is face {110}, the energy of faces {101}, {111}, {201} and others being considerably higher. We were able to obtain paratellurite single crystals as the growth pyramids of particular {110} face. The single crystals were 80 mm in diameter and 80 mm in height. The samples obtained were free of three-dimensional structural defects (bubbles), while the dislocation density was below $3 \cdot 10^3\ cm^{-2}$ [2].

[1] Yu. M. Smirnov. The growth of dislocation-free germanium single crystals. *Nonferrous Metals (USSR)*, 1977, No.5, p.48 (in Russian).
[2] Yu. M. Smirnov and A. I. Kolesnikov. The conception of particular singular face (after the example of paratellurite). In: *Physics of Crystallization* (Tver, TSU, 1994), p. 24 (in Russian).

PS12.01.15 FIELD ION MICROSCOPIC OBSERVATION OF Si-SiO_2 INTERFACE. M. Umeno, M.Tagawa, N.Ohmae and M.Miyanaga, Department of Material & Life Science, Osaka University, Yamada-oka, Suita, 565 JAPAN.

The atomic arrangement of interfacial layer of Si-SiO_2 system was directly observed with a field ion microscope (FIM). The existence of some structural and/or compositional transition layer at the interface of a-SiO_2 and Si substrate has been pointed out by many reports, yet the direct observation of its structure has been of great concern. Si tips with [001], [011] and [111] axes were prepared with chemical or electrolytic etching from CZ-Si wafers. After some successive treatments for obtaining atomic FIM images, tips were thermally oxidized with 300L of dry oxygen at 1000K in the FIM chamber. The image of an interfacial transition layer was easily recognized, as the oxide image which was composed of diffusely at random distributed bright spots change into the image of dense rather small spots when field evaporation was conducted, and the image of Si substrate partly appeared. The present FIM observation revealed followings:

1. The thickness of the transition layer is so thin as 2 to 3 atomic layers.
2. The transition layer has a crystalline nature.
3. The evaporation field strength has an orientation order, that is (001) < (011) < (111), and this order does not correspond to either of the orientation order for oxidation velocity or of the field strength on the tip.
4. The evaporation field strength of SiO_2 was estimated to be 34V/nm which is somewhat lower than 40V/nm of Si.

A fairly perfect image of substrate Si could be obtained when all oxide layer was removed by the field evapaoration.

PS12.01.16 INFLUENCE OF H_2-, O_2- AND Ar-PLASMA ON THIN Al_2O_3-FILMS A.Quade, C.Eggs*, H.Wulff, M.Schmidt** E.-M.-A.-University, Institute of Physical Chemistry, 17489 Greifswald, Germany * E.-M.-A.-University, Department of Physics 17489 Greifswald, Germany **E.-M.-A.-University, Institute of Low-Temperature Plasma Physics, 17489 Greifswald, Germany

We have investigated the influence of H_2-, O_2- and Ar-plasma on the formation and stability of alumina layers on aluminium. The Al-films were deposited on smooth Si (100) wafer. The thickness of the films varies between 20 and 65 nm. An alumina layer of about 2 nm grew on the surface of the Al-films by atmospheric corrosion. The thin films were treated in a plasma of a HF-discharge (100 kHz, 100 W) with a gas pressure of 1 mbar and a flow rate of 5 sccm.

The layers were investigated with grazing incidence x-ray reflectometry (GIXR) before and after plasma treatment. XPS and AFM were used additionally to get information about the chemical composition and the structure of the surface.

As a result of the H_2-treatment we found an increase of the thickness of the whole film of about 10 nm. The O_2-treatment showed only a small increase of the thickness, while Ar-plasma had no influence of the thickness.

In order to fit the reflectometry measurements best results were obtained under the assumption of a multilayer system of γ-Al_2O_3, Al and γ-Al_2O_3.

The O_2- and Ar-plasma treatment causes a smoothing of the surface of the layers and their interfaces, while in contrast H_2-plasma causes a strong increase of the roughness of the layer. XPS-investigations show that the surface of films only consists of Al_2O_3. The AFM-measurements corroborate the influence of the different plasma on the surface roughness.