TEMPERATURE DEPENDENCE OF GROWTH RATES FOR BASAL {0001} AND MINOR RHOMBOHEDRAL {01 $\bar{1}$ 1} FACES IN QUARTZ

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Rates of quartz growth and dissolution in water and various aqueous solutions have been a subject of extensive studies for a long time. At the same time, activation energy (an important kinetic parameter) for growth of different quartz faces still needs more accurate determination. Growth rates of quartz basal {0001} and minor rhombohedral {01 $\bar{1}$ 1} faces in alkaline aqueous solutions 1M NaOH) were determined in autoclave experiments within 300 - 360°C temperature interval and at ~1 kbar pressure. Method of temperature drop (ΔT) [1,2] was applied, ΔT being 10°C. Autoclaves were filled with the silica-saturated alkaline water solution, prepared in advance.

It was found, that growth rates exponentially grew from 0.09 to 0.44 mm/day and 0.03 to 0.15 mm/day respectively for {0001} and {01 $\bar{1}$ 1} faces between 300°C and 360°C. Experimental conditions and results are presented in Figs. 1 and 2, showing that:

1. Relation between growth rates of the {0001} and {01 $\bar{1}$ 1} faces remained roughly the same (about 3), which is somewhat higher, than in other works [1,2].

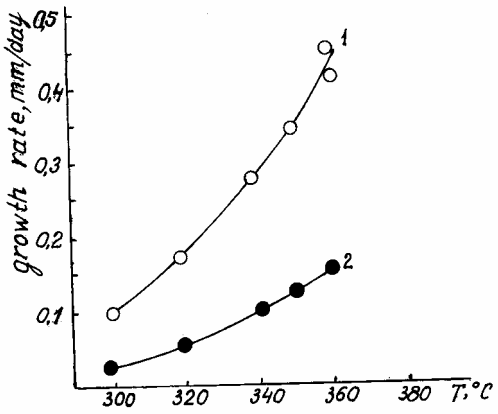

Fig.1. Dependence of the quartz growth rates upon temperature: {0001} basal plane (1) and {01 $\bar{1}$ 1} minor rhombohedron (2) (1M NaOH solution, 1 kbar pressure and 10°C temperature drop).

2. Growth rates of the {0001} and {01 $\bar{1}$ 1} faces increased exponentially according to Arrhenius law as temperatures went higher. From practically the same slope of the "logarithm of the rate – inverse temperature" curves for both faces (Fig. 2), it follows that activation energies for growth of the {0001} and {01 $\bar{1}$ 1} faces were essentially the same, being 20 ± (1-2) kcal/mol (84 ± (1-2) kJ/mol). The result coincides with the activation energy estimation, made for the {0001} face by Laudise [3]. At the sametime, the obtained value for activation energy of the minor rhombohedral face {01 $\bar{1}$ 1} (20 kcal/mol) differs from the value for the same face in [3] (14 kcal/mol), but, as it was mentioned in [3], the latter needed more accurate determination.

If taking as Chernov [4], that the growth rates of the kinked basal and flat minor rhombohedral faces are controlled by fitting of particles in the kinks, than the E values for those facts should be equal, because energy states of the basal kinks and minor rhombohedron step ones (i.e. the broken bonds energies) are likely to be approximately the same.

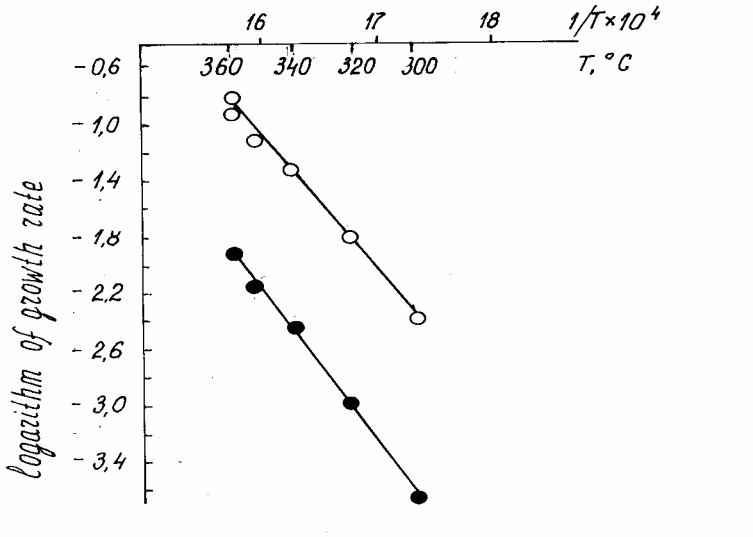

Fig.2. Linear dependence of the growth rate logarithms upon the inverse temperature, 1/T: {0001} basal face (upper line) and $\{01\bar{1}1\}$ minor rhombohedral face (lower line) (1M NaOH solution, 1 kbar pressure and 10°C temperature drop)

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