The alkali metal lithium sulphates, MeLiSO₄, constitute an important group of materials with interesting ferroelectric and ferroelastic properties. Orthorhombic LiCsSO₄ has been observed to undergo a structural pure ferroelastic, typical second-order phase transition at 203 K. The ferroelastic behaviour similar to that observed in LiNH₄SO₄ and LiKSO₄ has been investigated in detail. The monoclinic angle in the low-temperature phase has been interpreted as an order parameter. Its temperature variation in the range of two degrees below T_c agrees very well with predictions of Landau theory.

Lattice parameters have been determined as a function of the temperature in the range from 160 up to 550 K by using the Bond single-crystal diffractometer and copper radiation. The monoclinic strain has been measured by applying an attachment consisting of an additional silicon crystal which has converted our diffractometer into a two-crystal spectrometer. On basis of obtained results the thermal expansion and strain tensor have been calculated.

Optical inspection by means of a polarizing microscope with a special attachment applying a cold nitrogen flow indicates that in the monoclinic phase below 203 K the optical indicatrix rotates around the c-axis with decreasing temperature. The ferroelastic domains are clearly observable and their pattern changes with a lowering temperature in a very characteristic way contrary to that observed in LiNH₄SO₄ and LiKSO₄.

### Table 1

<table>
<thead>
<tr>
<th>Material</th>
<th>Temperature</th>
<th>Space Group</th>
<th>Phase Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>RbLiSO₄</td>
<td>477 K</td>
<td>Pcmn</td>
<td>A' 1</td>
</tr>
<tr>
<td>Cs₅.75Rb.25</td>
<td>453 K</td>
<td>Pcmn</td>
<td>B 1</td>
</tr>
<tr>
<td>Cs₅.5 Rb</td>
<td>343 K</td>
<td>Pcmn</td>
<td>B 1</td>
</tr>
<tr>
<td>Cs₅.75Rb.25</td>
<td>203 K</td>
<td>Pcmn</td>
<td>B 1</td>
</tr>
</tbody>
</table>

### Text (continued)

X-ray studies of CsLiSO₄ - RbLiSO₄ phase system have revealed successive structural phase transformations with ferroelastic and incommensurate phases. In our previous paper we presented the X-ray structure analysis of the RbLiSO₄, Cs₅.5Rb₂.5LiSO₄ and CsLiSO₄ crystals. New results has been obtained using X-ray analysis and optical methods at temperature range from 140 K to 600 K. It was found that concentration of Cs ions above x=0.4, the intermediate monoclinic phase B existed at low temperature. For the phase B the ferroelastic structure along b axis was investigated. The observation of the monoclinic phase II under polarizing microscope showed ferroelastic domain structure along c axis below the transition point which at low temperature gradually disappeared. For small Cs concentration an additional intermediate ferroelectric - ferroelastic phases A and B' did appear. The domain structure of these phases is of typical mosaic pattern. Basing on the crystal structure analysis and the temperature dependence of domain structure the phase transitions for Cs₅.75Rb.25LiSO₄ mixed crystal have been discussed. The detected structural transformations are summarized in table 1.

#### Fig. 1

[Graph or image of the phase transition graph]

#### Fig. 2

[Graph or image of the phase transition graph]
Single crystals of Na₂SO₄.III are grown by metastable nucleation from aqueous solutions at 50°C. This phase is orthorhombic with space group Cmcm and cell constants $a = 5.607\,\text{Å}$, $b = 8.569\,\text{Å}$, $c = 6.957\,\text{Å}$, $Z = 4$. The structure consists of tetrahedral and octahedral framework. The thermal vibrations of most of the atoms are large along c-axis (Zett. Krist. – In Press). Single crystals of this phase III (fig. 3b: Weissenberg photograph O-layer) on heating up to phase I and cooling, show oriented domains of phase III and phase II in the same crystals (fig. 3a: Weissenberg photograph 0-layer).

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05.1-36 ON THE LOW TEMPERATURE PHASE TRANSITION IN (NH₄)₂SO₄. By Y.A. Badr, S. Said, M. Mikhail and S. Awad, Faculty of Science, Cairo University, Cairo, Egypt.

An ultracryostat of type KT"905" and multidecameter (NF-Dekameter type WTW) provided with a special cell were used to determine the temperature dependence of the dielectric constant and dielectric loss over a wide range of frequencies of polycrystalline ammonium sulphate in the region of the low temperature phase transition. A sharp increase was observed in the values of $\varepsilon'$ & $\varepsilon''$ at about -50°C. Besides, a dielectric dispersion was detected and it was found to be more pronounced in the higher temperature phase of (NH₄)₂SO₄. This dispersion was attributed to piezoelectric resonance (Badr. et al., Physica stat. solidi [a]53, K51 [1979]). The observed sudden increase in the values of the dielectric constant and dielectric loss below -50°C was inferred to the ferroelectric behaviour of phase II of (NH₄)₂SO₄.

DTA studies showed that also a sharp peak at -50°C which indicated that the phase transition occurring in ammonium sulphate at -50°C was of the first order type. TMA thermograms showed that this transition was associated with a rapid increase in the expansion coefficient. Such increase in the lattice parameter might be attributed to the enhanced rotation of electric dipoles associated with the deformed SO₄ rings. The deformation of the SO₄ ions, in addition to their orientational motion, are thought to be responsible for the ferroelectric behaviour of (NH₄)₂SO₄ below -50°C.

05.1-37 CRYSTAL STRUCTURE CHANGES AND PRINCIPAL DEFECTS IN IRRADIATED CRYSTALS. By B.V. Kolontssova, A.B. Korneyev, V.I. Lutsenko, Moscow State University, Karpov Institute of Physics and Chemistry, Moscow, USSR.

Under the influence of radiation the crystals of Ca₃SiO₅, CaO₂, BaTiO₃, PbZrO₃, SrO₂, K₂B₂O₅, Ca₃O₃ and SiO₂ (quartz, cristobalite) transform into the structural states, which are close to the high-temperature phases of unirradiated crystals. The investigation of radiation defects and comparison of crystal structure changes under the influence of irradiation and heating are important for the determination of such transformation mechanisms.

By using X-ray diffuse scattering and X-ray crystal structure analysis it was shown that in neutron-irradiated quartz $E > 0.5$ keV; $\beta = 6 \times 10^{19}$ mon⁻²; $T_{irr} \sim 100°C$ structural states intermediate between A and B-quarts are formed (E.V. Kolontssova, A.B. Korneyev, V.I. Lutsenko, Dokl. Akad. Nauk SSSR, 1979, 247, 80). The dose dependence of these changes are qualitatively analogous to those in unirradiated crystals at about the $\beta$ - $\gamma$ phase transition temperature. The investigation of diffuse X-ray scattering intensity $(I_q)$ dependence of $q$ (q-distance between reciprocal space point and the next nearest reciprocal lattice node) showed, that $I_q$ falls off like $q^{-2}$. $I_q \sim q^{-2}$ means (P.H. Dederichs, J. Phys. (1973), 23, 471), that isolated point defects are principal defects in neutron-irradiated quartz and therefore they are responsible for the new structural states.

The changes of diffraction pattern from single crystal and powder Ca₃O₃ during heating and $\beta$ and $\gamma$-irradiation ($0.1 - 3.0 \times 10^{19}$; $E > 1.3$ keV; $T_{irr} \sim 40°C$) were also studied.

Analysis of these experimental results allows to make a conclusion, that radiation-induced transformation of crystal structure is realized without forming of displacement spikes. According to the analysis of our and literature data one can conclude that it is possible to consider isolated point defects concentration as an instability parameter under the influence of radiation for some compounds (such as A-$\beta$-SiO₂, BaTiO₃, Ca₃O₃, and maybe K₂B₂O₅, PbZrO₃).