Growth of Functional Oxide Single Crystals from a Sodium Chloride Flux

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Summary

Sodium chloride was successfully used as a new flux to grow strontium chlorapatite, $Sr_5Cl(PO_4)_3$, single crystals by a slow cooling method. The crystals of $Sr_5Cl(PO_4)_3$ belong to the hexagonal system with space group $P6_3/m$. Sodium chloride has a low melting point with sufficient solubility in water. In addition, NaCl is nontoxic to humans.

The crystal growth of $Sr_5Cl(PO_4)_3$ was conducted by heating a mixture of solute and flux at 1100 ℃ for 10 h, and then cooling to 450 ℃ at a rate of 5 ℃/h. The hexagonal prism-shaped crystals with lengths of up to 8.6 mm and widths of 2.1 mm were grown. The hexagonal needle crystals with lengths of up to 2.6 mm and widths of 60 μm were also grown. The obtained crystals were colorless and transparent. Typical prismatic crystals of $Sr_5Cl(PO_4)_3$ are shown in Fig.1. Taking the sizes and forms of grown crystals into account, the most suitable solute content for the growth of $Sr_5Cl(PO_4)_3$ crystals was 0.2 mol%. The resulting crystals could be readily separated by dissolving the NaCl flux in warm water. Sodium chloride was found to be a suitable flux to grow $Sr_5Cl(PO_4)_3$ crystals.

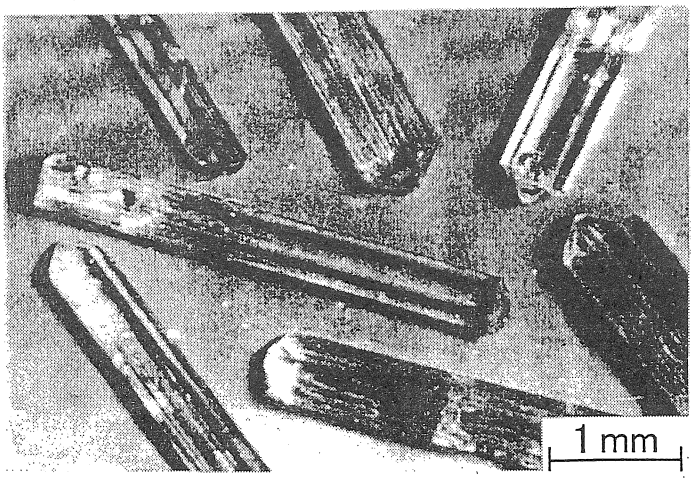

Fig.1 Prismatic $Sr_5Cl(PO_4)_3$ crystals grown from NaCl flux.

The prismatic and needle $Sr_5Cl(PO_4)_3$ crystals were bounded by the $\{10\bar{1}0\}$ and $\{10\bar{1}1\}$ faces. The crystals were elongated in the $\langle 0001 \rangle$ directions. Strontium, phosphorus, and chlorine atoms were distributed homogeneously. No Na^+ ions were incorporated into the crystals. The lattice parameters were determined as a=9.954(2) Å and c=7.167(3) Å. The density was pycnometrically determined to be 4.09 ± 0.02 g/cm^3.