

## Growth of Functional Oxide Single Crystals from a Sodium Chloride Flux

Shuji Oishi and Takaomi Suzuki

Department of Environmental Science and Technology,  
Faculty of Engineering, Shinshu University

### Summary

Sodium chloride, NaCl, was successfully used as a flux to grow calcium molybdate, CaMoO<sub>4</sub>, single crystals by a slow cooling method. The crystals of CaMoO<sub>4</sub> belong to the tetragonal system with space group *I*4<sub>1</sub>/*a*. Sodium chloride has a low melting point with sufficient solubility in water. In addition, NaCl is nontoxic to humans.

The solubility of CaMoO<sub>4</sub> in NaCl increased with a rise in temperature, reaching 3.2 mol% (11.3 g/100 g NaCl) solubility at 900 °C. The crystal growth of CaMoO<sub>4</sub> was conducted by heating a mixture of solute and flux at 900 °C for 10 h, and then cooling to 550 °C at a rate of 5 °C/h. Well-formed octahedral crystals with lengths of up to 3 mm were grown. The cylinder-shaped needle crystals with lengths of up to 5.2 mm were also grown. Typical needle crystals of CaMoO<sub>4</sub> are shown in Fig.1. The obtained octahedral and needle crystals were colorless and transparent. The crystal sizes were dependent on the solute content. The most suitable solute content for the growth of CaMoO<sub>4</sub> crystals was 3 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 CaMoO<sub>4</sub> crystals.

The long and short octahedral crystals were bounded by the {101} and {112} faces, respectively. The crystal surfaces were very flat. The needle crystals were elongated in the <001> directions, with respect ratios ranging from 160 to 670. Calcium, molybdenum, and oxygen atoms were distributed almost homogeneously in the octahedral and needle crystals. No Na<sup>+</sup> and Cl<sup>-</sup> ions from the flux were incorporated into the crystals. The lattice parameters were determined as  $a=5.226(3)$  Å and  $c=11.43(1)$  Å. The density was pycnometrically determined to be  $4.24 \pm 0.03$  g/cm<sup>3</sup>. The quality of the crystals was high.

Sodium chloride is an environment-friendly flux for growing CaMoO<sub>4</sub> crystals.

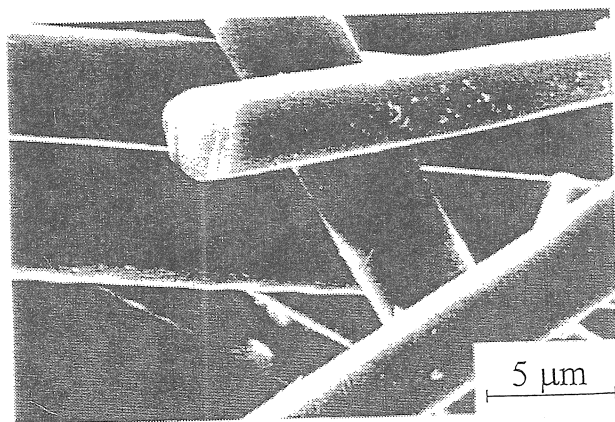


Fig.1 Needle crystals of CaMoO<sub>4</sub> grown from NaCl flux.