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THE OPTICAL PROPERTIES OF SOME INORGANIC
FLUORIDE AND CHLORIDE COMPOUNDS

T. N. McVay
G. D. White

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METALLURGY DIVISION

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THE OPTICAL PROPERTIES
OF SOME INORGANIC FLUORIDE
AND CHLORIDE COMPOUNDS

T. N. McVay and G. D. White
Metallurgy Division

ABSTRACT

Optical properties are listed for various fluoride and chloride compounds.

INTRODUCTION

In the course of investigation of various inorganic fluoride and chloride systems, it was found advisable to determine the optical properties of numerous fluoride and chloride compounds.

The optical data collected on these substances are recorded in this report. The refractive indices are believed to be precise to ± 0.003 ; the optic angles of biaxial crystals were estimated.

The authors wish to acknowledge the assistance of W. C. Whitley, B. J. Sturm, R. J. Sheil, J. Truitt and Virginia Coleman, who prepared the samples under the direction of C. J. Barton and W. R. Grimes of the Materials Chemistry Division, of which G. H. Clewett is the head.

OPTICAL PROPERTIES

Beryllium lead fluoride, $\text{BeF}_2 \cdot \text{PbF}_2$

Biaxial -
 $\alpha = 1.602$
Colorless
 $2V = 70^\circ$
 $\gamma = 1.627$

Cesium uranium fluoride, $\text{CsF} \cdot \text{UF}_4$

Biaxial +
 $\alpha = 1.553$
Polysynthetic twinning, $X \wedge c = 10^\circ$
Z = sky blue
 $2V = 45^\circ$
 $\gamma = 1.560$
X = greenish blue

Cesium uranium fluoride, $2 \text{CsF} \cdot \text{UF}_4$

Biaxial +
 $\alpha = 1.516$
Z = light blue
 $2V = 45^\circ$
 $\gamma = 1.524$
X = light greenish blue

Cesium zirconium fluoride, $\text{CsF} \cdot \text{ZrF}_4$

Biaxial -
 $\alpha = 1.464$
Colorless
 $2V = 20^\circ - 45^\circ$ (varies)
 $\gamma = 1.476$

Cesium zirconium fluoride, $2 \text{CsF} \cdot \text{ZrF}_4$

Uniaxial -
 $\alpha = 1.482$
Colorless
E = 1.460

Iron fluoride, FeF_2

Uniaxial +
 $\alpha = 1.524$
Brown
E = 1.540

Lead uranium fluoride, $\text{PbF}_2 \cdot \text{UF}_4$

Uniaxial -
 $\alpha = 1.750$
Green
E = 1.730

Lead uranium fluoride, $6 \text{PbF}_2 \cdot \text{UF}_4$

Isotropic
 $n = 1.77$
Light blue

Lithium beryllium fluoride, $\text{LiF} \cdot \text{BeF}_2$

Uniaxial +
 $O = 1.312$ $E = 1.319$
Colorless

Lithium chromium fluoride, $3 \text{LiF} \cdot \text{CrF}_3$

Biaxial - $2V = 40^\circ$
X normal to one face
 $\alpha = 1.444$ $\gamma = 1.464$
Green

Lithium uranium fluoride, $\text{LiF} \cdot 2\text{UF}_4$

Biaxial - $2V = 10^\circ$
 $\alpha = 1.584$ $\gamma = 1.600$
Yellowish green

Lithium uranium fluoride, $3 \text{LiF} \cdot \text{UF}_4$

Biaxial + $2V = 45^\circ$
 $\alpha = 1.468$ $\gamma = 1.476$
Z = dark green X = light green

Lithium zirconium fluoride, $\text{LiF} \cdot \text{ZrF}_4$

Biaxial + $2V = 30^\circ$
 $\alpha = 1.468$ $\gamma = 1.476$
Colorless

Lithium zirconium fluoride, $2 \text{LiF} \cdot \text{ZrF}_4$

Uniaxial +
 $O = 1.462$ $E = 1.482$
Colorless

Manganese fluoride, MnF_2

Uniaxial +
 $O = 1.476$ $E = 1.504$
 $O = \text{colorless}$ $E = \text{gray}$

Potassium aluminum fluoride, 3 KF·AlF₃

Isotropic
n = 1.376
Colorless

Potassium chromium fluoride, 3 KF·CrF₃

Isotropic
n = 1.422
Green

Potassium fluoride, acid KF·HF

Uniaxial - Some crystals show small optic angle.
O = 1.354 E = 1.331
Colorless

Potassium sodium iron fluoride, 2 KF·NaF·FeF₃

Isotropic
n = 1.414
Colorless

Potassium thorium fluoride, 3 KF·ThF₄

Isotropic
n = 1.424
Colorless

Potassium uranium chloride, KCl·UCl₄

Biaxial + 2V = small
α = 1.692 β = 1.705
γ = 1.759
X = gray Z = blue-green

Potassium uranium fluoride, KF·UF₄

Uniaxial -
O = 1.510 E = 1.504
Green

Potassium uranium fluoride, 2 KF·UF₄

Uniaxial +
O = 1.484 E = 1.512
Light olive drab

Potassium zirconium fluoride, $\text{KF}\cdot\text{ZrF}_4$

Biaxial +
 $\alpha = 1.488$
Colorless

$2V = 75^\circ$
 $\gamma = 1.504$

Rubidium beryllium fluoride, $\text{RbF}\cdot\text{BeF}_2$

Biaxial +
 $n_{\text{av.}} = 1.390$ with low birefringence
Colorless

Rubidium uranium fluoride, $\text{Rb}\cdot\text{UF}_4$

Biaxial -
 $\alpha = 1.514$
Polysynthetic twinning, $Y \wedge c = 20^\circ$
Z = blue

$2V = 75^\circ$
 $\gamma = 1.528$
X = green

Rubidium uranium fluoride, $2 \text{RbF}\cdot\text{UF}_4$

Biaxial +
 $\alpha = 1.473$
Z = light violet

$2V = 70^\circ$
 $\gamma = 1.487$
W = light green

Rubidium uranium fluoride, $3 \text{RbF}\cdot\text{UF}_4$

Isotropic
 $n = 1.438$
Green

Rubidium zirconium fluoride, $2 \text{RbF}\cdot\text{ZrF}_4$

Uniaxial -
 $n_o = 1.438$
Colorless

$E = 1.432$

Rubidium zirconium fluoride, $3 \text{RbF}\cdot\text{ZrF}_4$

Isotropic
 $n = 1.432$
Colorless

Sodium beryllium fluoride, $\text{NaF}\cdot\text{BeF}_2$

Biaxial
 $n = 1.312$ with low birefringence
Length slow
Colorless

Sodium beryllium fluoride, $2 \text{ NaF} \cdot \text{BeF}_2$

Biaxial
 $n = 1.303$ with low birefringence
Yllc
Colorless

Sodium chromium fluoride, $3 \text{ NaF} \cdot \text{CrF}_3$

Isotropic
 $n = 1.411$
Green

Sodium fluoride, acid $\text{NaF} \cdot \text{HF}$

Uniaxial +
 $n_o = 1.261$ $n_e = 1.328$
Colorless

Sodium thorium fluoride, $2 \text{ NaF} \cdot \text{ThF}_4$

Uniaxial +
 $n_o = 1.468$ $n_e = 1.496$
Colorless

Sodium uranium chloride, $2 \text{ NaCl} \cdot \text{UCl}_4$

Uniaxial -
 $n_o = 1.664$ $n_e = 1.652$
Pale green

Sodium uranium fluoride, $\text{NaF} \cdot \text{UF}_4$

Uniaxial -
 $n_o = 1.520$ $n_e = 1.512$
Green

Sodium uranium fluoride, $2 \text{ NaF} \cdot \text{UF}_4$

Uniaxial -
 $n_o = 1.495$ $n_e = 1.490$
Green

Sodium uranium fluoride, $3 \text{ NaF} \cdot \text{UF}_4$

Uniaxial -
 $n_o = 1.417$ $n_e = 1.411$
Greenish blue

Sodium zirconium fluoride, $3 \text{ NaF} \cdot 4 \text{ ZrF}_4$

Biaxial + $2V = 30^\circ$
 $\alpha = 1.420$ $\gamma = 1.432$
Colorless

Sodium zirconium fluoride, $\text{NaF} \cdot \text{ZrF}_4$

Uniaxial -
 $O = 1.508$ $E = 1.500$
Indices vary depending on $\text{NaF}:\text{ZrF}_4$ ratio
Appears to be a solid solution
Colorless

Sodium zirconium fluoride, $2 \text{ NaF} \cdot \text{ZrF}_4$

Biaxial - $2V = 75^\circ$
 $\alpha = 1.412$ $\gamma = 1.419$
Colorless

Sodium zirconium fluoride, $3 \text{ NaF} \cdot \text{ZrF}_4$

Uniaxial -
 $O = 1.386$ $E = 1.381$
Colorless

Thorium fluoride, ThF_4

Isotropic
 $n = 1.532$
Colorless

Uranium chloride (III) UCl_3

Uniaxial, probably -
High index 2.04 $\text{Low index } 1.94$
Dark brownish red

Uranium chloride (III) UCl_4

Uniaxial -
 $O = 2.03$ $E = 1.95$
 $Z = \text{greenish brown}$ $X = \text{light brownish green}$

Zirconium chloride ZrCl_4

Probably monoclinic
Biaxial $\text{Large } 2V$
 $\gamma = 1.83$ $\alpha = 1.76$
 $Z \wedge c 22^\circ$
White