dissymmetry. Furthermore this length is certainly an overestimate since coiling of chains and/or cross linking would result in a decrease in the longest dimension of the particle.

The results of the present study seem to be best summarized by a hydrolytic process for thorium whereby a continuous series of aggregates are formed above $\bar{n}$ = 1.0, beginning with the formation of dinuclear and trinuclear species near hydroxyl number 1.5–2.0 and leading to the formation of very large particles prior to precipitation of hydrous oxide or basic salts above hydroxyl number 3.0. Although no measurements were made between hydroxyl numbers 2.0 and 3.0, the existence of polymers of intermediate molecular weight seems quite likely in this range. Such a continuous polymerization scheme for hydrolysis would lend credence to the hypothesis that hydrous oxide or basic salt structures are approximated in solution prior to precipitation, but the validity of this theory and the general nature of this phenomenon are subject to the results of considerable further work along these lines.

Finally, the results of this work are believed to be of the usual accuracy obtained in light-scattering work, the polymerization numbers reported being most likely accurate to within less than ±10%.

Acknowledgment.—This work was supported by a grant from the U. S. Army Research Office, Durham, N. C. We wish to thank Dr. D. G. Sharp of the Biophysics Laboratory of the School of Medicine for the use of a Model 1974 Brice-Phoenix light-scattering photometer.

CONTRIBUTION FROM THE DEPARTMENT OF CHEMICAL ENGINEERING,
THE UNIVERSITY OF TEXAS, AUSTIN, TEXAS

The Phase Equilibria and Crystal Chemistry of the Rare Earth Group VI Systems. III. Neodymium–Tellurium[1]

BY W. LIN, H. STEINFINK, AND E. J. WEISS

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The phases occurring in the neodymium–tellurium system are: NdTe, f.c.c. a = 6.278 Å., m.p. 2040°. A solid solution series Nd_3Te_4–Nd_2Te_3 which has a high temperature, Th_3P_4-type structure, whose cubic lattice constant varies from 9.434 to 9.424 Å., respectively; a phase transition occurs at 1000° to an orthorhombic modification, Pbnm, a = 11.94 Å., b = 12.24 Å., c = 4.407 Å.; Nd_3Te_4 melts at 1680° and Nd_2Te_3 melts at 1620°. A solid solution series exists over the composition range $NdTe_{1.74}$ to $NdTe_2$; the tetragonal unit cell for $NdTe_2$ has dimensions a = 4.419 Å., c = 9.021 Å., space group $P^4/_nmm$, and the compound melts at 1270°. The phase Nd_2Te_5 is orthorhombic, pseudotetragonal, $a = b$ = 4.380 Å., c = 44.0 Å., space group Bmmb, and melts incongruently at 910°. $NdTe_3$ is orthorhombic, Bmmb, and the dimensions of the pseudotetragonal cell are a = 4.350 Å., c = 25.8 Å. The compound melts incongruently at 830°.

Introduction

Two intermediate phases in the neodymium–tellurium system, NdTe and Nd_2Te_3, have been reported. Iandelli[2] found that NdTe was isostructural with NaCl, and Nd_2Te_3 has been shown by Miller, *et al.*,[3] to exhibit solid solubility ranging to the composition Nd_3Te_4. The body-centered cubic Th_3P_4-type structure, which is frequently observed for rare earth–group VI compounds having the 2:3–3:4 composition range, is observed for Nd_2Te_3, although Miller[3] and Flahaut, *et al.*,[4] report a phase transformation to the orthorhombic system below 1000°. No complete investigation of the binary phase diagram has been reported and the aim of this investigation is to determine all the intermediate phases which exist in this system and to study their crystal chemistry.

Experimental

Neodymium ingots of 99.9% purity were obtained from the Nuclear Corporation of America and tellurium of 99.99% purity was obtained from the American Smelting and Refining Co. The region of the phase diagram 60–100 atom % Te was investigated by sealing the appropriate compositions of the elements in evacuated silica tubes and allowing them to react for at least 2 weeks at temperatures below 700°. Extensive reaction between neodymium metal and the silica surfaces occurred if the reaction temperature exceeded 700°. The intermediate phases $NdTe_3$, Nd_2Te_5, and $NdTe_2$–$NdTe_{1.74}$ were prepared in this manner. Mixtures containing less than 60% tellurium did not yield satisfactory results because at temperatures below 700° equilibrium could not be established and higher temperatures caused the formation of Nd_2O_3. In order to prepare the neodymium-rich compounds the mixtures were allowed to prereact in silica tubes for approximately 100 hr. and then sealed into tantalum tubes. These specimens were then heated in a vacuum induction furnace at approximately 2000° for 2–5 min. This procedure was very satisfactory for the preparation of Nd_2Te_3 and its solid solution compositions and for NdTe. The reacted, neodymium-rich, compositions can be equilibrated in silica tubes

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[1] This work is being sponsored by a grant from the U. S. Air Force Office of Scientific Research.

[2] A. Iandelli, *Gazz. chim. ital.*, **85**, 881 (1955).

[3] J. F. Miller, F. D. Reid, C. K. Matson, S. W. Moody, R. D. Baxter, and R. C. Himes, Technical Documentary Report No. AL TDR 64-239, Office of Technical Service, U. S. Department of Commerce, Washington, D. C., 1964.

[4] J. Flahaut, L. Domange, M. Guittard, M. P. Pardo, and M. Patrie, *Compt. rend.*, **257**, 1530 (1963).

at high temperatures and no attack on the container surfaces occurs. Although no visible reaction with the quartz container surfaces took place, minute amounts of oxygen contamination in the samples cannot be ruled out.

Single crystal and powder X-ray diffraction techniques were used to identify the phases. Microscopic examination of the reacted materials was very useful because the differences in color of the various phases served as a good criterion for their identification. The chemical composition of the specimens was determined by a chelometric titration of neodymium,[5] and tellurium was determined by the sodium thiosulfate procedure. The densities of the materials were determined by the displacement method using acetone as the liquid.

Results

Phase Diagram.—The condensed phase diagram for the Nd–Te system is shown in Figure 1. The solid lines represent that portion of the diagram which was located from a study of quenched samples and the dashed lines represent areas which are uncertain. The solid dots of Figure 1 represent the compositions which were quenched at those temperatures and the open circles represent melting point observations. The system has five intermediate phases and two regions of continuous solid solubility. Two of the phases melt incongruently and one phase displays a phase transition.

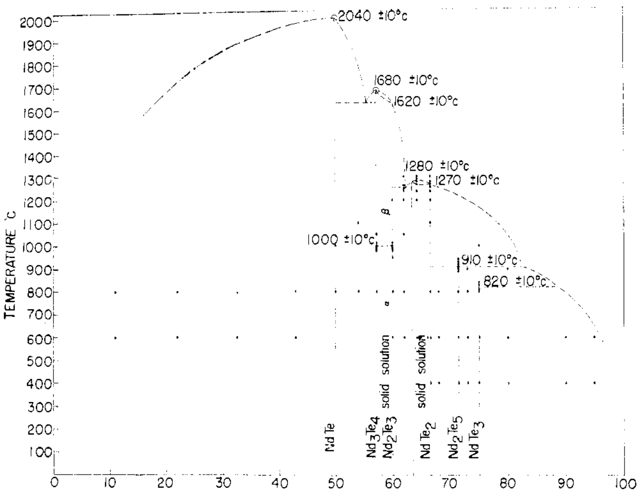

Figure 1.—The condensed phase diagram, Nd–Te. Full circles represent quench data; open circles are observed melting points. The dashed lines indicate uncertain phase boundaries.

X-Ray diffraction powder patterns of samples quenched at 400° containing 95, 90, and 80 atom % Te showed the presence of Te and $NdTe_3$, while these compositions quenched at 600° showed the presence of $NdTe_3$ and melt. No attempts were made to define a eutectic point precisely.

Quenching studies of single phase $NdTe_3$ specimens at various temperatures and subsequent X-ray diffraction and microscopic examination showed that this phase melts incongruently at 820 ± 10°. Specimens, with tellurium compositions between 75 and 71.4 atom %, which were quenched at temperatures below 820° contained Nd_2Te_5 and $NdTe_3$ in equilibrium, while observations on such samples between 820 and 910° showed Nd_2Te_5 and melt. The determination of the melting point of Nd_2Te_5 by quenching studies of the single phase material shows that the compound undergoes a peritectic decomposition to $NdTe_2$ and melt at 910 ± 10°. X-Ray diffraction patterns obtained from compositions containing 71.4 to 66.7 atom % Te and quenched below 910° reveal the presence of $NdTe_2$ and Nd_2Te_5.

Specimens containing 66.7 atom % Te as well as samples prepared with slightly lower Te contents had identical X-ray patterns, except that the diffraction lines shifted their positions. The lattice parameters of the end members of this solid solution series were determined from specimens quenched from the two-phase regions $NdTe_2$–Nd_2Te_5 and $NdTe_{2-x}$–Nd_2Te_3. The composition of the tellurium-deficient end member was established as $NdTe_{1.74}$ by preparing samples which varied in steps of 0.1 atom % Te and determining the shifts of the lattice parameters. After the appearance of the second phase, Nd_2Te_3, no further shifts in the lattice parameters take place, Figure 2. Samples of $NdTe_2$ which were sealed into evacuated quartz ampoules and quenched above 1100° are believed to be deficient in Te because the lattice parameters were observed to shift. The observed changes did not indicate that the end members tend toward the same composition as the melting point is approached, but this possibility cannot be excluded. It is assumed that if initially the compound had been contained under atmospheric pressure it would not have dissociated, and therefore the lines in Figure 1 representing the end members of the solid solution series are shown vertical. Specimens quenched at 1260° showed no change in appearance and were recovered as granular powders, while specimens quenched at 1270° and above were recovered as buttons and had obviously been molten. The quenching did not proceed rapidly enough because the melted material gave the diffraction patterns of the

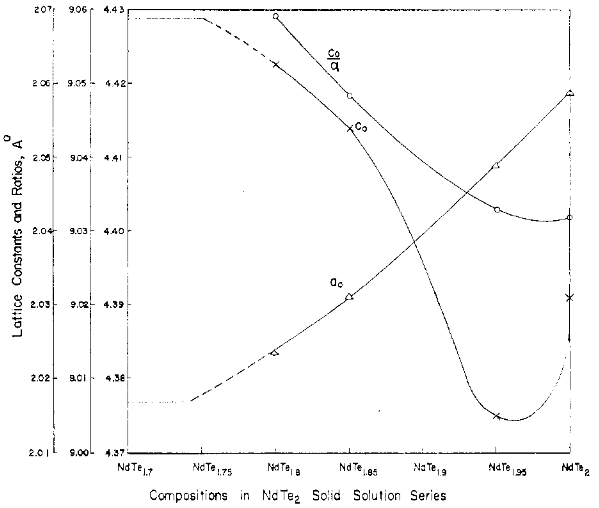

Figure 2.—Room temperature variation of lattice constants, *c*, *a*, and *c*/*a* as a function of composition in $NdTe_2$ solid solution.

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[5] J. S. Fritz, R. T. Oliver, and D. J. Pietrzyk, *Anal. Chem.*, **30**, 1111 (1958).

TABLE I

CRYSTALLOGRAPHIC DATA FOR COMPOUNDS IN THE NEODYMIUM–TELLURIUM SYSTEM

Compound	Space group	Unit cell dimensions, Å.	X-Ray density, g./cc.	Measd. density, g./cc.	Molecules per unit cell	M.p., °C.	Color
$NdTe_3$	Bmmb	$a = b = 4.350$ $c = 25.8$	7.17	7.00	4	820[b]	Gold
Nd_2Te_5	Bmmb	$a = b = 4.380$ $c = 44.0$	7.29	7.10	4	910[b]	Dark gold
$NdTe_2$[a]	$P^4/_nmm$	$a = 4.419$ $c = 9.021$	7.53	7.35	2	1270	Black
$NdTe_{1.74}$[a]	$P^4/_nmm$	$a = 4.377$ $c = 9.060$					Silver-gray
Nd_2Te_3[a]	$I\bar{4}3d$	$a = 9.424$	7.10	7.30	5.33	1620	Silver-gray
Nd_3Te_4[a]	$I\bar{4}3d$	$a = 9.434$	7.46	7.33	4	1680	Black
Nd_2Te_3–Nd_3Te_4 Low-temperature form	Pbnm	$a = 11.94$ $b = 12.24$ $c = 4.407$			4	1000[c]	
NdTe	Fm3m	$a = 6.278$	7.30	7.5	4	2040	Purple

[a] Solid solution series. [b] Incongruent. [c] Phase transition.

crystalline compound. It is considered that melting occurred congruently because the liquid appears to have had the same composition as the solid, and the behavior is indicated in Figure 1 as analogous to the melting of the Nd_2Te_3–Nd_3Te_4 solid solution.

A region of solid solubility exists between the limits 60–57.1 atom % Te. The phase transformation of the high-temperature, Th_3P_4-type structure to the low-temperature, orthorhombic structure occurs at 1000 ± 10°. The melting points of Nd_2Te_3 and Nd_3Te_4 were determined by a procedure previously described[6] and are considered to be congruent because the molten material after solidification always had the X-ray diffraction pattern of the crystalline solid.

Only one additional intermediate compound, NdTe, exists. The procedure to establish the melting point and the evidence for believing that it is congruent are the same as for Nd_2Te_3.

Crystal Data.—The crystallographic and physical parameters for the intermediate phases are summarized in Table I. The X-ray powder diffraction data are given in Table II.

$NdTe_3$.—The compound is easily identified by its striking gold color, metallic luster, and brittleness; it will tarnish slowly when exposed to air. Single crystal X-ray data can be indexed on a pseudo-tetragonal cell, although the diffraction symmetry is orthorhombic and the extinctions place the crystal into space group Bmmb (No. 63) or into one of the other two space groups consistent with these extinctions. The crystal structure appears to consist of layers of neodymium and tellurium atoms which are stacked along the c axis. It is isostructural with $ErTe_3$[6] and $LaTe_3$.[7,8] *Anal.* Calcd. for $NdTe_3$: Nd, 27.37; Te, 72.63. Found: Nd, 26.6; Te, 72.1.

Nd_2Te_5.—This compound is similar in color to $NdTe_3$ but has a darker metallic luster. This similarity caused difficulty in distinguishing optically between the two compounds in the early part of the study. The X-ray powder pattern is similar to that of $NdTe_3$ and initially it was thought to be part of a Nd-rich solid solution of this phase. Single crystal diffraction data can be indexed on a pseudo-tetragonal cell. Ordered single crystals are difficult to obtain and most of them display stacking faults, but those which are ordered have diffraction symmetry which is orthorhombic, and hkl reflections are present when $h + l = 2n$; $hk0$ when $k = 2n$. The space group is Bmmb or one of the other two space groups consistent with these extinctions. The material tarnishes easily in air and its color turns from dark gold to gray-black within several hours. After several days of exposure to the atmosphere a single crystal mounted on a goniometer head produced only a powder pattern. *Anal.* Calcd. for Nd_2Te_5: Nd, 31.14; Te, 68.86. Found: Nd, 30.5; Te, 68.4.

$NdTe_2$–$NdTe_{1.74}$.—Single crystal X-ray patterns of $NdTe_2$ can be indexed on the basis of a tetragonal cell and the space group is $P^4/_nmm$. This phase is probably isostructural with Fe_2As.[9] The limits of solid solubility were established by the procedure described above and the variations in lattice parameters are shown in Figure 2. *Anal.* Calcd. for $NdTe_2$: Nd, 36.11; Te, 63.89. Found: Nd, 35.9; Te, 63.0.

Nd_2Te_3–Nd_3Te_4.—The high-temperature modification of this phase has the Th_3P_4 structure. The cubic lattice parameters for the end members of the solid solution series were determined as 9.424 Å. for Nd_2Te_3 and 9.434 Å. for Nd_3Te_4; Miller[3] reported the corresponding values as 9.439 and 9.456 Å. The small shift in lattice constant with increasing Nd content is typical of these solid solutions.[7,10] The color of Nd_2Te_3 is silver-gray and gradually turns black as the composition changes to Nd_3Te_4. Single crystal X-ray patterns were obtained from both polymorphs and the high-temperature form has space group $I\bar{4}3d$; the low-temperature form is orthorhombic, space group Pbnm.

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(6) D. J. Haase, H. Steinfink, and E. J. Weiss, *Inorg. Chem.*, **4**, 541 (1965).

(7) T. H. Ramsey, Ph.D. Dissertation, University of Texas, Austin, Texas, 1964.

(8) F. L. Carter, Metallurgy of Semiconductor Materials, Interscience Publishers, New York, N. Y., 1961, p. 260.

(9) L. Domange, J. Flahaut, M. Pardo, A. Chirazi, and M. Guittard, *Compt. rend.*, **250**, 857 (1960).

(10) W. H. Zachariasen, *Acta Cryst.*, **2**, 57 (1949).

TABLE II

X-RAY POWDER DIFFRACTION DATA FOR THE INTERMEDIATE PHASES OF THE Nd–Te SYSTEM[a]

$NdTe_3$

$d_{obs.}$ Å	$d_{calc.}$ Å	h k l	$I_{obs.}$*
3.22	3.225	008	s
3.06	3.058	016	w
	3.054	111	
2.90	2.896	113	vs
2.64	2.642	115	s
2.36	2.362	117	w
2.18	2.175	200	m
1.868	1.865	11,11	m
	1.863	214	
1.847	1.843	00,14	w
1.804	1.803	208	m
	1.806	10,13	
1.669	1.666	218	w
	1.668	11,13	
	1.663	20,10	
1.538	1.538	220	m
1.407	1.415	034	vw band
	1.406	20,14	
1.389	1.388	228	w
1.360	1.358	313	m
	1.361	018; 11,17	
1.331	1.329	315	w
1.290	1.289	317; 12,15	w band
	1.293	309	
	1.295	20,16	
	1.296	10,19	
	1.290	00,20	
1.190	1.195	323;12,17;20,18	w broad band
1.187	1.186	234;31,11	
	1.182	10,21	
1.183	1.181	22, 14	
1.176	1.175	325	w
	1.172	216	
	1.173	00,22	
1.034	1.034	145	w^+
	1.030	408	
	1.031	32,13;2022	
	1.039	12,21	
1.020	1.025	331,416	w
	1.018	333	
	1.019	31,17;03,18	
0.980	0.978	11,25	m^-
0.934	0.933	22,22;10,27	w^-
0.932	0.931	428;14,13	w^-

Nd_2Te_5

d_{obs}Å	d_{calc}Å	hkl	I_{obs}
3.13	3.136	00,14	s
3.09	3.100	01,10	w
	3.089	111	
2.93	2.950	10,11	vs
	2.921	115	
2.62	2.615	119	s
2.45	2.447	11,11	w
	2.439	00,18	
	2.433	10,15	
2.20	2.195	00,20	m
	2.190	200	
1.855	1.852	11,19	w
	1.845	218	
1.829	1.829	00,24	vw
1.800	1.795	20,14	m
1.627	1.630	10,25,2018	vw broad
	1.628	12,15	
	1.625	11,23	
1.556	1.561	12,17	w^+
	1.550	20,20	
	1.549	220	
1.404	1.404	20,24	vw broad
	1.399	309	
	1.398	21,22	
1.392	*		w
1.374			w
1.361			w
1.338			w
1.314			w^-
1.290			vw
1.222			vw
1.192			w broad
1.156			w
1.114			vw
1.101			vw
1.039			vw
1.023			w^+
.984			vw
.970			w^+
.940			vw
.928			vw

$NdTe_2$

d_{obs}Å	d_{calc}Å	hkl	I_{obs}
3.96	3.97	101	w
3.16	3.16	102	w^+
3.12	3.13	110	w^+
3.02	3.01	003	m
2.95	2.95	111	vs
2.56	2.568	112	s
2.48	2.485	103	m
2.20	2.209	200	m^+
1.829	1.828	114	vw
1.805	1.804	005	vw
1.786	1.782	203	m
1.670	1.670	105	w
1.648	1.651	213	w^+
1.558	1.562	115	w
1.425	1.424	106	w
1.395	1.397	130	vw
	1.400	032	
	1.397	205	
1.357	1.355	116	vw
1.332	1.333	215	m
1.198	1.196	216	w^+
1.132	1.127	008	vw
1.014	1.015	332	w
	1.014	325	
1.006	1.004	208	w
0.986	.984	333	vw
0.980	.979	218	vw
0.957	.954	119	vw
0.949	.946	334	vw
	.947	317	
0.920	.922	415	vw

*vs=very strong s=strong m=medium w=weak vw= very weak

*Due to the large c axis dimension, many different indices can be assigned to these lines and the resultant ambiguity makes it pointless to list them.

αNd_2Te_3

d_{obs}Å	d_{calc}Å	hkl	I_{obs}
4.27	4.27	220	vw
4.13	4.13	101	vw
3.57	3.576	021	w
3.41	3.406	211	m broad
3.37	3.369	230	
3.06	3.060	040	s
2.95	2.954	301	s
2.90	2.904	131	m
	2.900	410	
2.87	2.871	311	m
2.71	2.723	240	w
2.67	2.683	420	vs
	2.676	231	
	2.660	321	
2.46	2.460	141	w
2.42	2.426	340	vw
	2.423	411	
2.39	2.393	331	vw
2.31	2.317	241	vw
2.28	2.292	421	vvw
2.195	2.204	002	m
2.054	2.061	530	
1.879	1.883	540	w
	1.885	351	
1.839	1.839	322	vvw
1.815	1.815	360	vvw
1.508	1.509	470	vvw
1.501	1.505	371,532	w
	1.497	062	

$\beta\ Nd_2Te_3$

$d_{obs.}$ Å	$d_{calc.}$ Å	h k l	$I_{obs.}$
2.98	2.980	310	vs
2.52	2.518	321	s
2.11	2.107	420	w
2.01	2.009	332	w
1.924	1.924	422	m
1.849	1.848	510, 431	m
1.530	1.529	611,532	m^+
1.493	1.490	620	w
1.455	1.454	541	w
1.390	1.390	631	w^-
1.362	1.360	444	vw
1.335	1.333	710, 550, 543	vw
1.308	1.307	640	vw
1.283	1.283	721, 633, 552	m^-
1.258	1.259	642	w
1.198	1.197	732, 651	w
1.128	1.126	653	w^-
1.112	1.111	822, 660	w^-
1.096	1.096	831, 750, 743	w
1.069	1.067	752	w^-
1.030	1.028	842	vw
1.018	1.016	921, 761,655	m^-
0.995	0.993	930, 851,754	w^+
0.974	0.972	932, 763	vw
0.917	0.915	10,40; 864	w^-

NdTe

d_{obs}Å	d_{calc}Å	hkl	I_{obs}
3.12	3.136	200	s
2.21	2.218	220	m
1.812	1.812	222	w
1.569	1.570	400	w
1.403	1.404	420	w^+
1.280	1.281	422	w
1.109	1.110	440	vw
1.046	1.046	600,442	w^-
0.992	0.993	620	w^-

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[a] All patterns were obtained with nickel-filtered copper radiation.

NdTe.—This phase has been reported as isostructural with NaCl.[2,3] Powder diffraction patterns taken with Cu Kα radiation do not show diffraction lines for odd Miller indices. Such lines are due to the difference of the scattering power of the two atoms and with this radiation the difference is further decreased because of the dispersion corrections. The ratio of intensities of (200) to (111) is approximately 10^3 and it is therefore not surprising that (111) is not observed in a powder pattern. A very long exposure of a single crystal of NdTe using Mo Kα radiation and a precession camera showed that the (111) reflection was present and confirms the ordered, NaCl-type, arrangement of the atoms.

Discussion

The intermediate phases common to this system and the lanthanum–tellurium system[7] are isostructural and also duplicate the melting behavior, except that the lanthanum analogs melt at somewhat lower temperatures. The presence of the Nd_2Te_5 phase is unique for this system. The X-ray diffraction patterns for $NdTe_3$ and Nd_2Te_5 are very similar and the materials also have the same space group, so that the layer structures are very much alike. The compound $NdTe_3$ contains two Nd layers and six Te layers in the unit cell which on the average are 3.2 Å. apart. Nd_2Te_5 results from a substitution of some Te layers by Nd in the $NdTe_3$ structure so that the ordered structure contains four Nd and ten Te layers in the unit cell which on the average are 3.14 Å. apart. The shrinkage of the layer separation is due to the introduction of a smaller rare earth atom for the metalloid.

The phase transition exhibited by Nd_2Te_3–Nd_3Te_4 solid solution compositions is not observed in the corresponding lanthanum compounds. The low-temperature structure appears to be isostructural with Sb_2S_3[4] and Sb_2Se_3.[11] The occurrence of this transition may be a function of the radius ratio.[4]

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[11] N. W. Tideswell, F. H. Kruse, and J. D. McCullough, *Acta Cryst.*, **10**, 99 (1957).

CONTRIBUTION FROM THE REACTOR CHEMISTRY DIVISION,
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Crystal Structure of Hexagonal Sodium Neodymium Fluoride and Related Compounds[1]

BY JOHN H. BURNS

Received January 22, 1965

A single-crystal X-ray analysis has established the structure of hexagonal $NaNdF_4$. The unit cell has $a = 6.100$, $c = 3.711$ Å.; the space group is $P\bar{6}$. Fluoride ions lie in triangular arrays at $z = 0$, $^1/_2$. Cation sites are of three types: a onefold site occupied by Nd^{3+}, a onefold site occupied randomly by $^1/_2Na^+$, $^1/_2Nd^{3+}$, and a twofold site occupied randomly by Na^+ and vacancies. The fluoride coordination about the first two sites is ninefold, a trigonal prism with each vertical face bearing a pyramid, and about the third site is irregular octahedral. It is proposed that this structure becomes the same as that of several other compounds having Nd^{3+} replaced by other rare earth ions or Y^{3+} and of the mineral gagarinite when the cations of the first two sites are completely intermixed. Bond distances and thermal displacements are given for $NaNdF_4$.

Introduction

Sodium neodymium fluoride is a member of a series of 1:1 compounds existing in the binary systems NaF–MF_3, in which M is a rare earth or yttrium atom. The phase diagrams for these systems were reported by Thoma[2] and further details are forthcoming. Of interest to the present work is that all of the $NaMF_4$ compounds have a hexagonal crystalline form, while those for M = Y and Nd to Lu have a high-temperature form with the cubic, fluorite structure. Hund[3] deduced the structure of high-temperature $NaYF_4$ and concluded that Na^+ and Y^{3+} ions are distributed randomly over the cation sites. Recently the low-temperature $NaYF_4$ was observed to be hexagonal by Burns[4] and by Roy and Roy,[5] who assigned to it the β_2-Na_2ThF_6 structure proposed by Zachariasen[6] for $NaLaF_4$ and $NaCeF_4$, and by Sobolev *et al.*,[7] who called it isomorphous with the mineral gagarinite,[8] $NaCaMF_6$.

A complete single-crystal structure analysis has been carried out to establish the details of the hexagonal form of $NaNdF_4$, to resolve the points of conflict, and to aid in explaining the phase behavior of NaF–MF_3 systems.

Experimental

A 1:1 mixture of NaF and NdF_3 was melted and allowed to cool slowly; large, violet crystals of $NaNdF_4$ were obtained. X-Ray

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[1] Research sponsored by U. S. Atomic Energy Commission under contract with the Union Carbide Corporation.

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