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SYNTHESIS OF BASTNAESITE[1]

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In the course of a study of rare-earth fluocarbonate minerals, laboratory experiments were made in an attempt to synthesize bastnaesite. Seven of the runs were successful. Attempts to synthesize the rare-earth fluocarbonates directly from the rare-earth nitrates were unsuccessful. It was found, however, that the rare-earth carbonates could be converted to the fluocarbonate. For the successful runs the carbonate was first prepared by the reaction of the particular rare-earth nitrate with sodium carbonate. Analysis, in per cent, of the resultant basic carbonate, $Ce_2O(CO_3)_2 \cdot 4H_2O$, is as follows:

	Analysis	Theoretical
Ce_2O_3	66.9	67.3
CO_2	18.3	18.0
H_2O	15.1	14.7
Total	100.3	100.0

A 100-mg. sample of $Ce_2O(CO_3)_2 \cdot 4H_2O$ was dispersed in 500 ml. of hot distilled water in a CO_2 atmosphere and the stoichiometric amount (33 ml.) of very dilute HF (1/1000) was added slowly. The reaction product was kept in a CO_2 atmosphere and digested on the steam bath for 5 days. Subsequent experiments have shown that digestion on the steam bath over night is sufficient. Bastnaesite of the composition $CeFCO_3$ and (Ce, La)FCO_3 with Ce and La in a 1:1 ratio (in both the starting material and final product) were prepared in this manner.

Identification of the products was by *x*-ray powder diffraction patterns. A comparison between *d*-spacings and intensities of the lines of the natural and the synthetic bastnaesite is shown in Table 1.

Under the microscope the products from the runs appeared as very fine aggregates of grains with a high birefringence. The material is too fine grained for the optical sign to be determined, but it was found to have a low index (presumably ω) of $1.71\pm$ and a maximum index (ϵ) near 1.82. These indices agree with the optical properties of the natural material.

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TABLE 1. *X*-RAY POWDER DATA FOR NATURAL AND SYNTHETIC BASTNAESITE

CuKα radiation, $\lambda = 1.5418$ Å, nickel filter;
camera diameter 114.59 mm.; cutoff 12 Å

Synthetic bastnaesite, $CeFCO_3$ (Film no. 9502)[1] Hexagonal $P\bar{6}2c$, $a = 7.24$ Å, $c = 9.92$ Å[2]				Natural bastnaesite, (Ce, La)FCO_3 (Film no. 9943) Locality: Stove Mountain near Pikes Peak, Colorado Hexagonal $P\bar{6}2c$; $a = 7.12$ Å, $c = 9.80$ Å[2]			
I	*d*(meas.) Å	*d*(calc.) Å	*hkl*	I	*d*(meas.) Å	*d*(calc.) Å	*hkl*
71	4.96	4.94	002	35	4.90	4.88	002
100	3.62	3.63	110	71	3.56	3.56	110
100	2.92	2.92	112	100	2.88	2.87	112
9	2.46	2.48	004	6	2.44	2.45	004
2 b	2.29	2.31 2.28	104 203	2 2	2.28 2.23	2.28 2.24	104 203
50	2.09	2.09	300	50	2.06	2.05	300
50	2.03	2.05	301	35	2.01	2.01	301
35	1.92	1.925 1.925	302 123	50	1.892	1.897 1.897	302 123
6	1.81	1.813	220	13	1.778	1.779	220
18	1.70	1.700	222	24	1.675	1.674	222
2	1.64	1.653 1.642	006 132	1	1.629	1.614 1.633	006 132
13	1.59	1.597	304	13	1.573	1.575	304
9	1.49	1.504	116	6	1.482	1.484	116
9	1.46	1.462	224	13	1.437	1.440	224
4	1.37	1.356 1.368	126 140	9	1.344	1.338 1.346	126 140
18	1.32	1.319	142	24	1.296	1.298	142
4	1.29	1.296 1.291	306 207	4	1.277	1.278 1.275	306 207
b = broad							

[1] All lines diffuse.

[2] Cell constants were obtained from the powder patterns which were then indexed on the basis of the space group given by Donnay, Gabrielle, and Donnay, J. D. H. (1953), The crystallography of bastnaesite, parisite, roentgenite, and synchisite: *Am. Mineral.*, **38**, 932–963.