

TABLE V  
X-ray DIFFRACTION RESULTS  $\beta$ SmOOH

hkl	d <sub>obs</sub>	d <sub>calc</sub>	d <sub>calc</sub> -d <sub>obs</sub>	I/I <sub>0</sub>
002	5.609	5.606	-0.003	10
111	5.068	5.101	+0.033	3
112	4.004	4.007	+0.003	9
202	3.290	3.283	-0.007	100
220	2.867	2.864	-0.003	50
004	2.814	2.803	-0.011	15
310	2.557	2.562	+0.005	10
222		2.551	-0.006	
204	2.309	2.305	-0.004	25
400	2.023	2.025	+0.002	22
224	2.002	2.003	+0.001	30
401		1.993	-0.009	
314	1.892	1.891	-0.001	9
331		1.882	-0.010	
332	1.804	1.808	+0.004	12
420		1.812	+0.000	
305	1.722	1.725	+0.003	28
422		1.724	+0.002	
206	1.698	1.697	-0.001	12
333		1.700	+0.002	
404	1.639	1.642	+0.003	7
423		1.630	-0.009	
502	1.563	1.559	-0.004	12
226		1.565	+0.002	
424	1.519	1.521	+0.002	10

tetragonal unit cell given above. It is reasonable then to postulate a structure based on the fluorite structure and to ascribe the shortening of the C-axis, relative to the A-axis to hydrogen bonding.

Beta-SmOOH is easily converted to the hydroxide by boiling in water for 15 minutes. After air drying at 110° C, the weight loss on ignition to 1100° C is 12.6 percent, corresponding to the loss of 1.49 moles of H<sub>2</sub>O per mole of starting SmOOH. X-ray diffraction examination of this hydroxide gave the results shown in Table VI. These d-values have not been indexed and do not correspond to either of the two reported hydroxides as shown in the same table. Note that this hydroxide is not the same as the high pressure modification prepared by Shafer and Roy.

#### D. DENSIFICATION OF OXIDE CERAMICS

##### 1. Introduction

The importance of microstructure (average grain size, grain size distribution, pore distribution, orientation, etc.) upon physical properties has become increasingly apparent. Typically, high density is achieved in ceramic materials sintering at high temperature. However, the employment of high temperature often leads to excessive grain growth with a subsequent deterioration in mechanical properties. Control of the densification process by void elimination mechanism and/or by small amounts of second phase additions have in some instances allowed the achievement of high density with small grain size. These techniques, however, are quite specific and applicable to a limited number of materials. In preliminary studies at Avco/SSD, fully dense magnesium oxide was produced by high-pressure techniques at relatively low temperatures resulting in an extremely fine grain size and high hardness number. In further effort, a program concerned with the densification processes was undertaken. For this study, two classes of materials were chosen, e.g., 1) nearly isotropic face centered cubic (rock-salt structure) oxides MgO and NiO and 2) anisotropic hexagonal oxides, Al<sub>2</sub>O<sub>3</sub> and Cr<sub>2</sub>O<sub>3</sub>.

##### 2. Experimental

###### a. Starting Materials

1) MgO -- except as otherwise noted, all the MgO employed was Fisher electronics grade with an average particle size of 300A as determined by X-ray diffraction line broadening or 500A as determined by electron microscopy. Before use, the material was preheated to 600° C in air atmosphere to decompose any brucite present and drive off any volatiles.