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Hydrothermal Preparation of Compounds of the Type ABO_3 and AB_2O_4

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During the last few decades compounds of the type ABO_3 and AB_2O_4 have been extensively studied. Ceramic methods have been used for preparation.

We have investigated the applicability of hydrothermal methods for preparing $BaTiO_3$ and various other oxides. By reacting $Ba(OH)_2 \cdot 8H_2O$ with TiO_2 (anatase)

under hydrothermal conditions, $BaTiO_3$ is formed in the temperature range $380^\circ C - 450^\circ C$ and the pressure range 300–500 atm. Using freshly prepared $TiO_2 \cdot xH_2O$ and $Ba(OH)_2 \cdot 8H_2O$ tiny crystals of $BaTiO_3$ were formed in a 1 M NaOH solution, when treated in the pressure bomb for 70 h. The reaction did not take place in acid solution. The autoclaves used were in some cases of 20 ml volume and in others of about 100 ml volume. The autoclaves were lined with all silver tubing. Temperature was measured by a Pt-PtRh thermocouple connected to a Radiometer GVM 22 C galvanometer. The pressure was calculated from the percentage of fill of the autoclave and the temperature, using the values of density of water at different temperature and pressures determined by Kennedy.¹ The reaction product $BaTiO_3$ was identified from Guinier-powder patterns. A few single crystals large enough to be mounted on an X-ray goniometer were badly twinned.

Using the same method, the following compounds were prepared from the corresponding hydroxides and oxides: $CaTiO_3$, $SrTiO_3$, $CdTiO_3$, $PbTiO_3$, and $BaZrO_3$.

It is expected that bigger single crystals of $BaTiO_3$ and other compounds can be prepared from hydrothermal reactions by use of temperature gradient methods.

Preparation of $PbZrO_3$ from hydrothermal methods was unsuccessful. This was reported by Reed and Katz² too.

$CoAl_2O_4$ and $CoGa_2O_4$ were prepared under hydrothermal conditions from a mixture of the hydroxides. Preparation of the corresponding In-compound was unsuccessful. Ensslin and Valentiner³ could not prepare $CoIn_2O_4$ by using ceramic methods, and the existence of the compound is questionable.

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