

STUDIES ON THE PREPARATION AND CHARACTERIZATION
OF SOME URANIUM OXIDES, OBTAINED BY DIFFERENT
METHODS, NEEDED FOR UO₂ FUEL PREPARATION

A Thesis

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STUDIES ON THE PREPARATION AND CHARACTERIZATION
OF SOME URANIUM OXIDES, OBTAINED BY DIFFERENT
METHODS, NEEDED FOR UO_2 FUEL PREPARATION

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NOTE

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- 2- Electro analytical Chemistry.
- 3- Inorganic Reaction Mechanisms .
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LIST OF PUBLICATIONS

- (1) S.A.El-Fekey , M.El-Mamoon Yahia and Alaa M. Abd El-Razek
" Studies on Some Uranium Oxides in The Composition Range
 $UO_3-U_3O_8-z$ ".
Proceedings of The 1st International Conference in
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- (2) M.El-Mamoon Yahia, S.A. El-Fekey and Alaa M. Abd El-Razek
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STUDIES ON SOME URANIUM OXIDES IN THE
COMPOSITION RANGE $UO_3-U_3O_{8-z}$

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The degree of densification and the specific micro-structural features of grain size and porosity distribution that develop in sintered ceramic oxides depend markedly on processing conditions both subsequent and prior to the powder preparation ¹.

In the present investigation, four different crystallographic modifications of UO_3 designated as α , β , γ and δ as well as the amorphous (A)- UO_3 have been prepared by calcining washed and unwashed uranium peroxide, washed ammonium uranate, uranyl nitrate crystals and $UO_3 \cdot H_2O$ at different temperatures. The obtained UO_3 powders were calcined at $650^\circ C$ for 3 h in nitrogen atmosphere.

The apparent density was measured by the difference of volume of impregnation using kerosene. The latter was found most appropriate after having tried other organic liquids like methanol, ethanol, benzene, toluene, hexane, pentane, acetone and petroleum ether. The sequence of density of UO_3 powders appeared as follows: $\beta > \gamma > \alpha > A-UO_3 > \delta$. Pour and tap densi-

ties have been also measured.

The porosity of the UO_3 phases was calculated using the equation $P = D_T - D_p / D_T^2$. The sequence of porosity appeared as follows : $A-UO_3 > \alpha > \delta > \gamma > \beta$.

The stoichiometry of U_3O_8 phase was determined titrimetrically³. The O/U sequence appeared as follows : $\gamma > \delta > \alpha > A-UO_3 > \beta$ indicating that the stoichiometry of the U_3O_8 phase depends on the porosity of the UO_3 from which it was prepared except for $\beta-UO_3$. This can be explained by the fact that during $\beta-UO_3$ preparation, by rapid heating of ammonium uranate, an appreciable part of ammonia is retained by the solid. This retained ammonia reacts with the UO_3 leading to U_3O_{8-z} formation .

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THE IMPACT OF AMMONIUM AND NITRATE
IMPURITIES ON THE FORMATION OF URANIUM
OXIDES, IN THE COMPOSITION $UO_3-U_3O_{8-z}$,
NEEDED FOR CERAMIC UO_2 FUEL PREPARATION

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Four different crystallographic modifications of UO_3 designated as α , β , γ , and δ as well as the amorphous (A)- UO_3 have been prepared by calcining washed and unwashed uranium peroxide, washed ammonium uranate, uranyl nitrate crystals and $UO_3 \cdot H_2O$ at different temperatures. The obtained UO_3 powders were calcined at $650^\circ C$ for 3 hour in nitrogen atmosphere.

The apparent density was measured by the difference of volume of impregnation using kerosene. The latter was found most appropriate after having tried other organic liquids like methanol, ethanol, benzene, toluene, hexane, pentane, acetone and petroleum ether. The sequence of density of UO_3 powders appeared as follows: $\beta > \gamma > \alpha > A-UO_3 > \delta$. Pour and tap densities have been also measured.

The porosity of the UO_3 phases was calculated using the equation $P = D_T - D_p/D_T$. The sequence of the porosity appeared as follows: $A-UO_3 > \alpha > \delta > \gamma > \beta$.

The stoichiometry of the U_3O_8 phase was determined titrimetrically. The O/U sequence appeared as follows: $\gamma > \delta > \alpha > A-UO_3 > \beta$ indicating that the stoichiometry of the U_3O_8 phase depends on the porosity of the UO_3 from which it was prepared except for $\beta-UO_3$. This can be explained by the fact that during $\beta-UO_3$ preparation, by rapid heating of ammonium uranate, an appreciable part of ammonia is retained by the solid. This retained ammonia reacts with the UO_3 leading to U_3O_{8-z} formation.

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