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

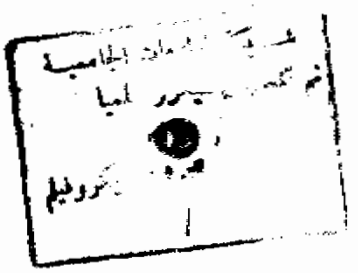
A Thesis

Submitted to

Chemistry Department,

Faculty of Science,

Ain Shams University.



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In Partial Fulfillment of

The Requirements for

The Degree of Master of Science

(Chemistry)

(1994)

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

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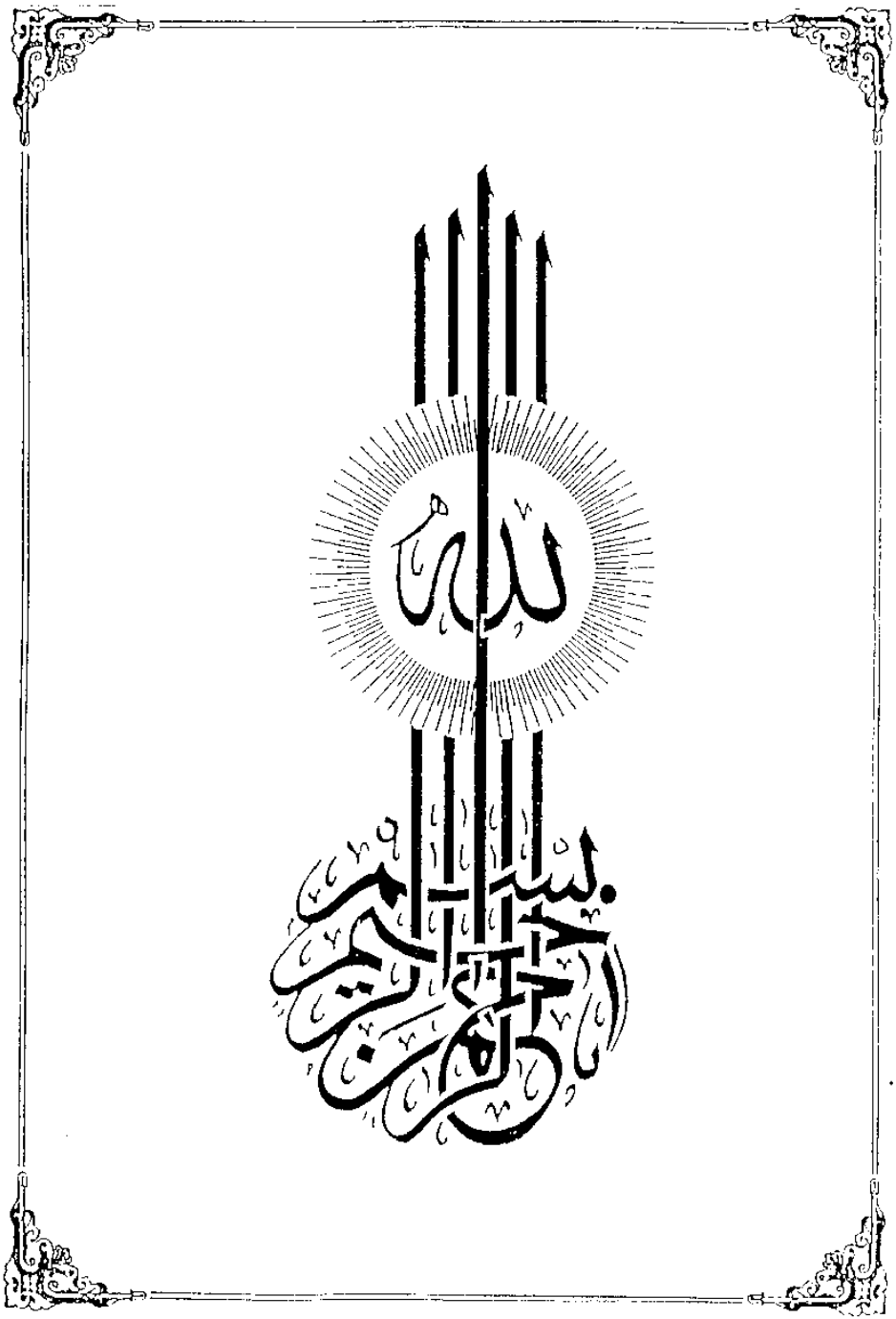

ACKNOWLEDGEMENT

The author would like to thank prof. Dr. M.F. EL-Shahat, Prof. of Inorganic and Analytical Chemistry , Faculty of Science , Ain Shams University , for his supervision , continuous help , genuine encouragement and sponsoring the work in the university .

He wish to express his thanks and deep gratitude to Ass. Prof. Dr.M.EL-Mamoon Yahia, Nuclear Chemistry Department, Atomic Energy Authority, Cairo , for suggesting the problem, close supervision , learned advice , guidance , p a tience , inspiration and continuous help throughout this study .

He is greatly indebted to prof. Dr. S. A. EL-Fekey, prof. of reactor materials , Nuclear Chemistry Department , Atomic Energy Authority , Cairo , for suggesting some topics of this work , continuous help, kind direction, learned advice, fruitful discussions throughout the whole work .

The author would like to express his great thanks to prof. Dr. F. H. Abou EL-Nour , Head of the Nuclear Chemistry Department , Hot Lab. Centre , Atomic Energy Authority , for his valuable help and interest .

Thanks are also due to the members of Nuclear Chemistry Department , Hot Lab. Centre , Atomic Energy Authority , for their assistance and cooperation .

NOTE

Beside the work carried out in this thesis, the candidate ALAA MOHAMMAD ABD EL-RAZEK has attended post-graduate courses for one year, covering the following topics :

1- Electrochemistry.
2- Electro analytical Chemistry.
3- Inorganic Reaction Mechanisms .
4- Organometallic Compounds .
5- Separation Techniques.
6- Nuclear Chemistry And its Applications .
7- Spectroscopic Application of Group Theory
8- Computer Science .
9- Instrumental Methods of Analysis .
10- Conformational Analysis.
11- Application of Spectroscopic Methods in Structural and Analytical Chemistry.
12- English Language.

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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 Chemistry and its Applications Doha , Qatar Abstracts p. 292 (1993).

(2) M.El-Mamoon Yahia, S.A. El-Fekey and Alaa M. Abd El-Razek "The Impact of Ammonium and Nitrate Impurities on the Formation of Uranium Oxides , in the Composition Range UO_3-U_3O_{8-z} ,Needed for Ceramic UO_2 Fuel Preparation".
Proceedings of The 1st International Conference in Chemistry and its Applications Doha , Qatar Abstracts p. 297 (1993).

1st Int. Conf. in Chemistry & its Applications (Doha, 1993)

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 microstructural 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_3have been prepared by calcining washed and unwashed uranium peroxide, washed ammonium uranate, uranyl nitrate crystals and $UO_3.H_2O$ at different temperatures. The obtained UO_3 powders were calcined at 650°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 > α > δ > γ > β.

The stoichiometry of U_3O_8 phase was determined titrimetrically[3]. The O/U sequence appeared as follows : γ > δ > α > A-UO_3 > β indicating that the stiochiometry of the U_3O_8 phase depends on the porosity of the UO_3 from which it was prepared except for β-UO_3. This can be explained by the fact that during β-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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2. S.A.EL-Fekey , M.EL-Mamoon Yahia and M.N.A. EL-Hakim, InternationalCeramicReview,1980, 29,40 .
3. S.A.EL-Fekey, M. Y. Farah and N. H. Rofail, Analytica Chimica Acta , 1977 , 89 , 413 .

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 amorphus (A)-UO_3 have been prepared by calcining washed and unwashed uranium peroxide, washed ammonium uranate, uranyl nitrate crystals and $UO_3 . H_2O$ at different temperatures. The obtained UO_3 powders were calcined at 650°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 mathanol, 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 β-UO_3. This can be explained by the fact that during β-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.

CONTENTS

Page

CHAPTER I

URANIUM OXIDES NEEDED FOR UO_2 FUEL PREPARATION

Page

CHAPTER II

EXPERIMENTAL

Page

CHAPTER III

THE IMPACT OF AMMONIUM AND NITRATE IMPURITIES ON THE FORMATION OF URANIUM OXIDES , PREPARED VIA URANIUM PEROXIDE ROUTE

CHAPTER IV

THE IMPACT OF AMMONIUM AND NITRATE IMPURITIES ON THE FORMATION OF URANIUM OXIDES , PREPARED VIA AMMONIUM URANATE ROUTE

Page

LIST OF TABLES