

Study on the Oxidation Behavior of spent MOX Simfuel  
at High Temperaturea in Air

, , \* , \*  
17  
\*  
150

(PWR MOX Simfuel)  
(900~1300°C) TGA(Thermo-Gravimetric Analysis)  
OM(Optical Microscopy)  
600°C 가 .  
가 가 가 1200°C U<sub>3</sub>O<sub>8</sub>  
UO<sub>3</sub> 가 .  
(0~50MWd/kgU) , ,  
가 가 가  
가 가 .

Abstract

The air oxidation of PWR MOX simfuel was investigated using thermo-gravimetric analysis and optical microscopy, focused on the high temperature range between 900 and 1300°C. In this high temperature range, sintered pellet specimen was not spalled by the air oxidation. And the oxidation rate was decreased with increasing the oxidation temperature. At temperatures above 1200°C, the weight loss was observed presumably by the U<sub>3</sub>O<sub>8</sub> decomposition and the UO<sub>3</sub> volatilization.

The effect of simulated burnup, from 0 to 50MWd/kgU, on the oxidation of

PWR MOX simfuel was investigated using same methods. The magnitude of fission product of simfuel was calculated using ORIGEN-S code in SCALE 4.3. In result, the oxidation rate was decreased with increasing the simulated burnup. But remarkable decreasing rate was not revealed.

1.

$UO_2$  [1-5],  
 MOX [6-9]  
 simfuel 가  
 $UO_2$  가 (dopant), (oxygen partial pressure)  
 [4, 10-17].  
 가 600°C 가  
 가 ,  
 가 [4, 11-12]. 1200°C 가  
 O/M 가 [4, 18].  
 가 가  
 가 가  
 doped- $UO_2$  가 가  
 $UO_2$  가 가  
 $UO_2$  fluorite 가 (valence) 가  
 가 가

2.

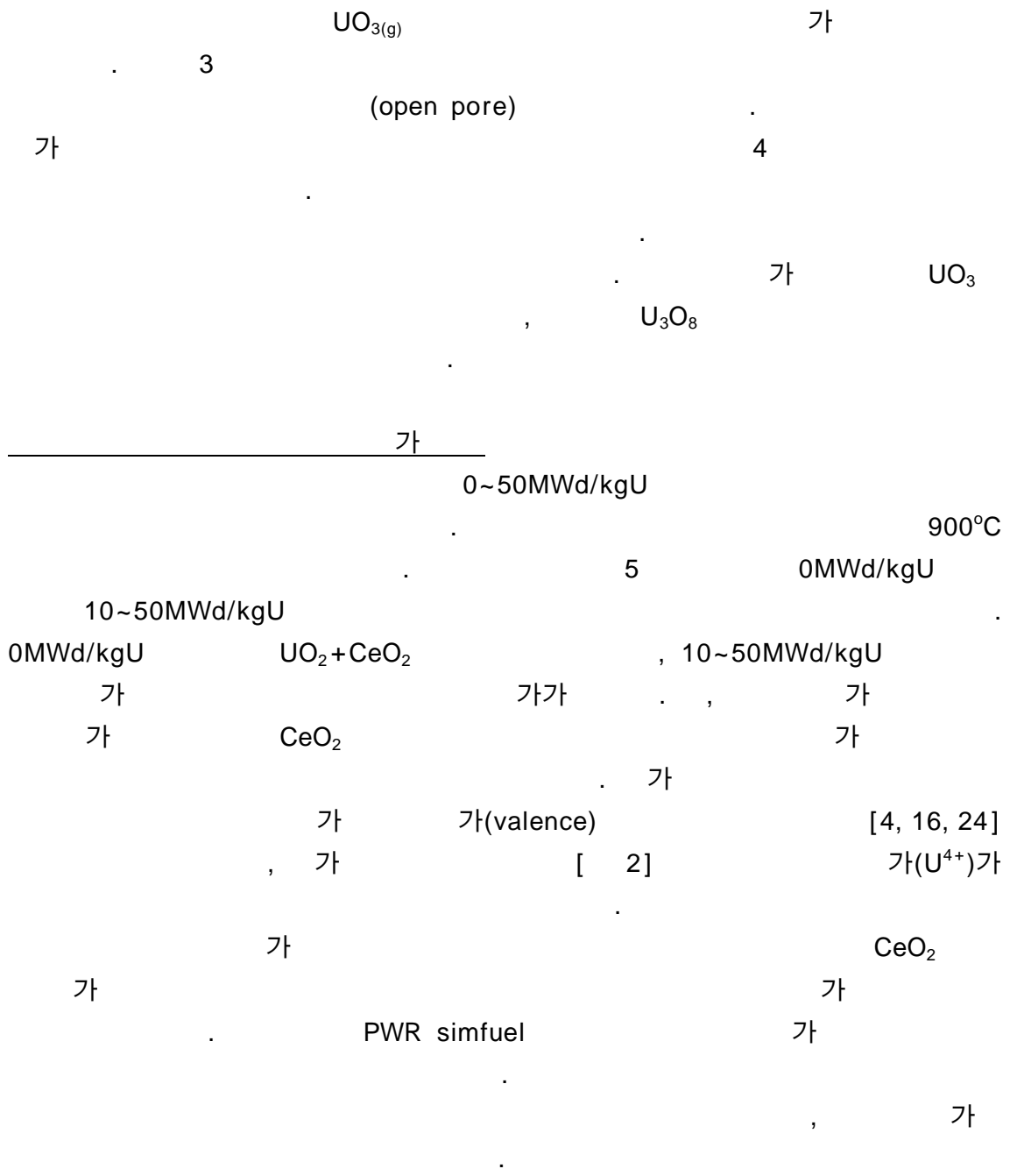
$UO_2$ -8.17mol% $CeO_2$  50MWd/kgU  
 SCALE 4.3 ORIGEN-S [19-20]

가 UO<sub>2</sub> 11 가 [ 1 ]  
 (PWR MOX Simfuel)  
 가  
 dry milling , 160RPM  
 5 ( 12 ) 3ton , 1700°C 6  
 (flowing H<sub>2</sub>)  
 1mm disk polishing  
 TGA(Thermo-Gravimetric Analysis) 가  
 , N<sub>2</sub> gas  
 , 900°C, 1000°C 1200°C 1300°C  
 OM(Optical  
 Microscopy, REICHERT MEF4 M)

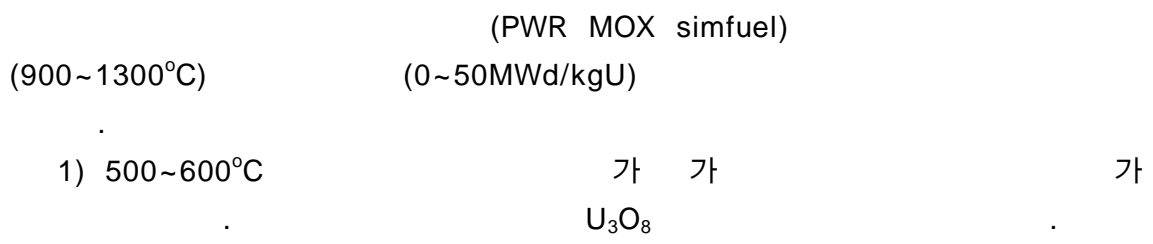
3.

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40MWd/kgU PWR MOX simfuel 900~1300°C  
 가  
 1 가 가 가 ,  
 1200°C 가  
 , 500~600°C U<sub>3</sub>O<sub>8</sub> (plasticity)  
 가 , U<sub>3</sub>O<sub>8</sub>가 (spalling)  
 [4]  
 가 가 가가  
 1  
 UO<sub>2</sub>  
 UO<sub>2+x</sub> oxygen potential 가 [21-22]  
 , 가 O/M  
 가 U<sub>3</sub>O<sub>8</sub> (decompose) UO<sub>2+x</sub>  
 가  
 1200~1300°C UO<sub>3(g)</sub> [ 2,  
 23] , UO<sub>3(g)</sub>  
 가 가



4.



2) 1200°C	가	가		
		U <sub>3</sub> O <sub>8</sub>	UO <sub>2+x</sub>	
1200~1300°C	UO <sub>3</sub>			
3) UO <sub>2</sub> +CeO <sub>2</sub>	가	가	가	가
		가	가	가
가			,	가

5.

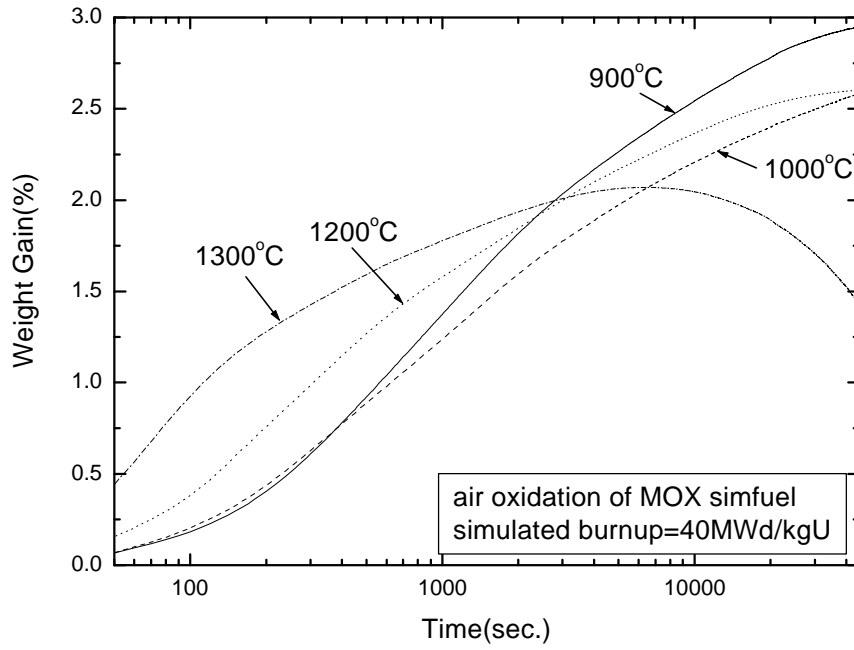
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1. ORIGEN-S 가  
(wt.%)

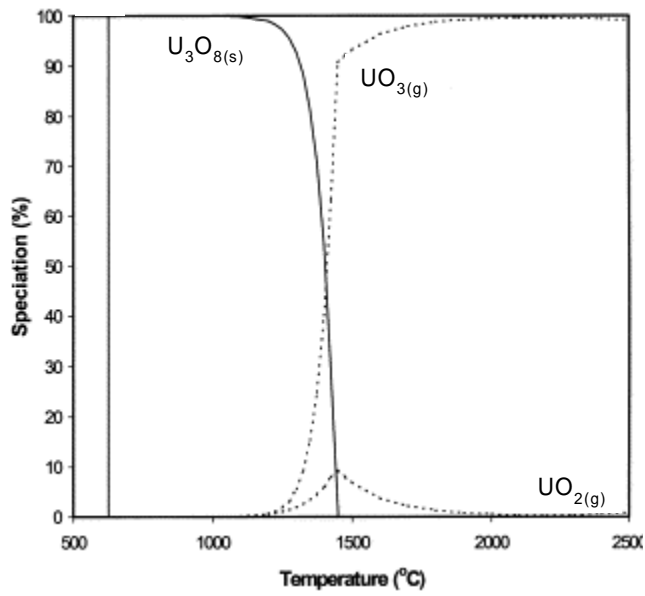
Compound	Simulated burnup(MWd/kgU)					
	0	10	20	30	40	50
UO <sub>2</sub>	93.41	93.22	93.00	92.75	92.45	92.10
BaO		0.05	0.09	0.13	0.17	0.21
CeO <sub>2</sub>	6.59	6.02	5.46	4.93	4.44	4.00
La <sub>2</sub> O <sub>3</sub>		0.04	0.08	0.12	0.16	0.20
MoO <sub>3</sub>		0.12	0.25	0.38	0.52	0.66
SrO		0.02	0.04	0.05	0.07	0.08
Y <sub>2</sub> O <sub>3</sub>		0.01	0.02	0.03	0.03	0.04
ZrO <sub>2</sub>		0.11	0.21	0.31	0.41	0.50
Rh <sub>2</sub> O <sub>3</sub>		0.02	0.05	0.08	0.10	0.12
PdO		0.06	0.13	0.22	0.30	0.40
RuO <sub>2</sub>		0.18	0.34	0.50	0.65	0.80
Nd <sub>2</sub> O <sub>3</sub>		0.16	0.33	0.51	0.69	0.87

\* UO<sub>2</sub>+8.2wt%PuO<sub>2</sub>(8.17mol%PuO<sub>2</sub>)

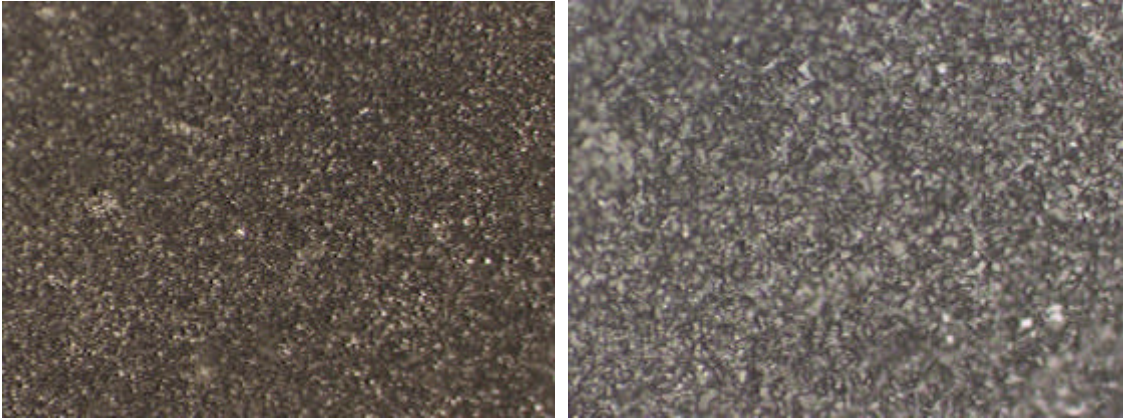
2. 가		가(valence)	
Elements	Valence	Elements	Valence
U	+4, +5, +6	Y	+3
Ba	+2	Zr	+4
Ce	+3, +4	Rh	+2, +3, +4
La	+3	Pd	+2, +4
Mo	+2, +3, +4, +5, +6	Ru	+2, +3, +4, +6, +8
Sr	+2	Nd	+3



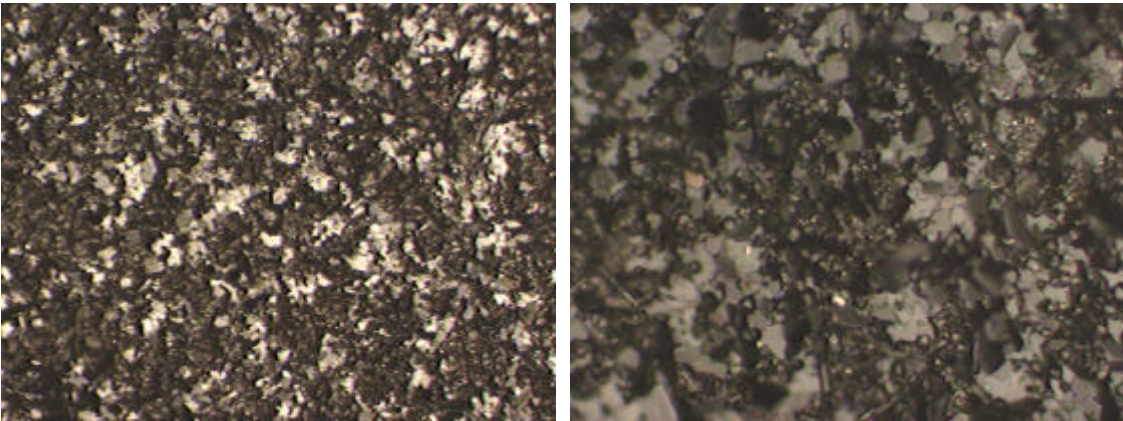
1. PWR MOX simfuel 가  
(simulated burnup=40MWd/kgU)



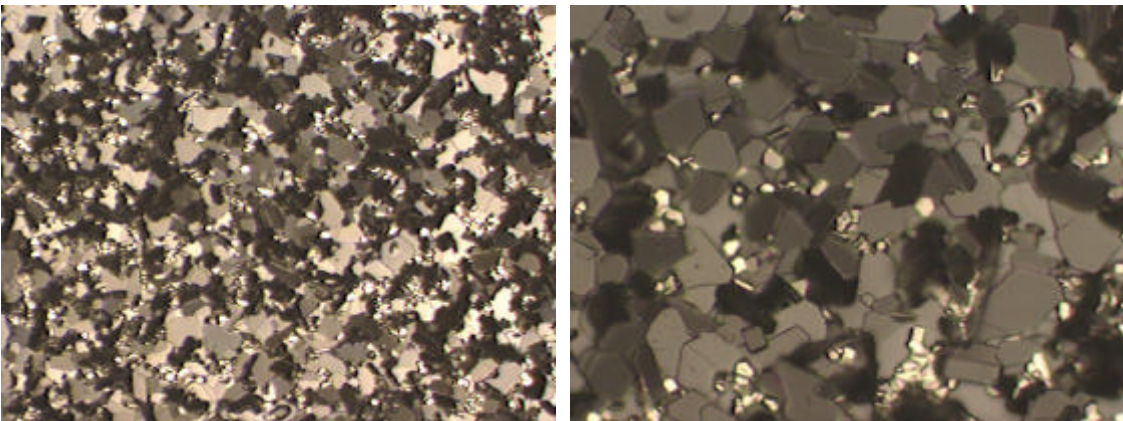
2. Gibbs free energy  
: T.C. Ho et al.[23]



(a) 900°C



(b) 1000°C

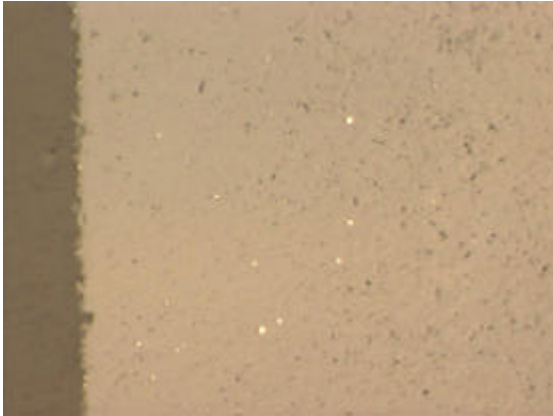


(c) 1200°C

3. PWR MOX simfuel

(OM, ×200, ×500)

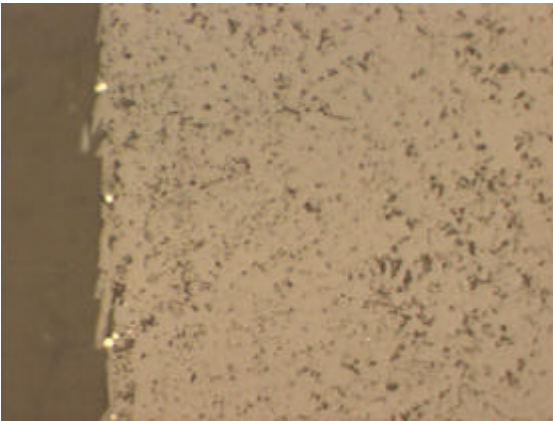




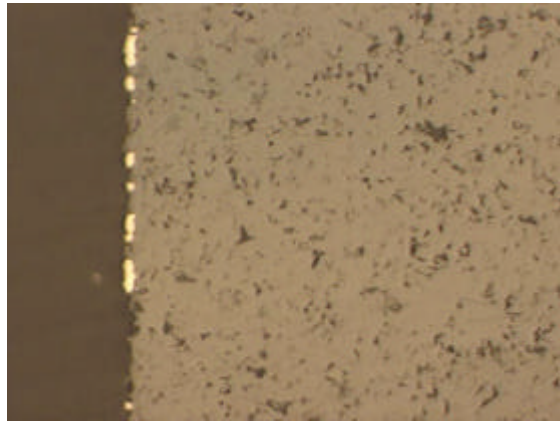
(a) 900°C



(b) 1000°C



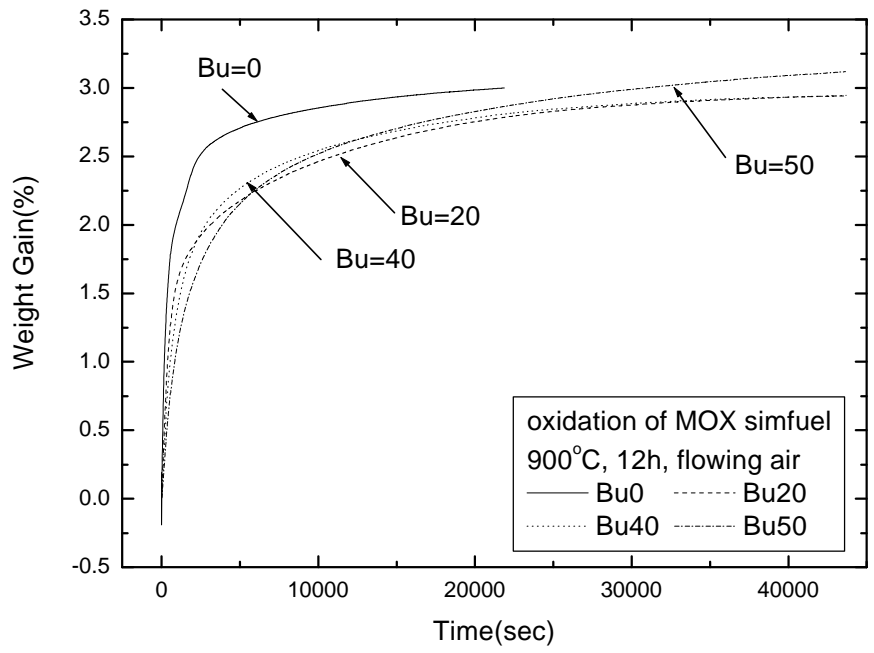
(c) 1200°C



(d) 1300°C

4. PWR MOX simfuel

(OM, ×500,  
mount)



5. PWR MOX simfuel

( =900°C)