

Percolation (Rim)
Analysis of pore interconnection in rim structure by percolation method

150

UO₂ (rim) 가 percolation

Abstract

The possibility of rim pore interconnection to the outer surface of high burnup LWR UO₂ fuel pellet in rim structure, which could affect fission gas release behavior, was analyzed by percolation method. Because most pores were analyzed not to be interconnected to the surface in the range of porosity observed, the fission gas release would not be affected by pore interconnection in the rim structure. Only some pores near the surface of fuel pellet could make open pathes to the surface of fuel pellet.

1.

가 가 가 40
GWd/tM UO₂ (Rim) 가 [1].
2~3
70~80 GWd/tM [1].
0.15~0.3 μm 1 μm

μm , 120 GWd/tM
[1].

70 GWd/tM
150~200 μm

50~80

percolation
가

2. Percolation

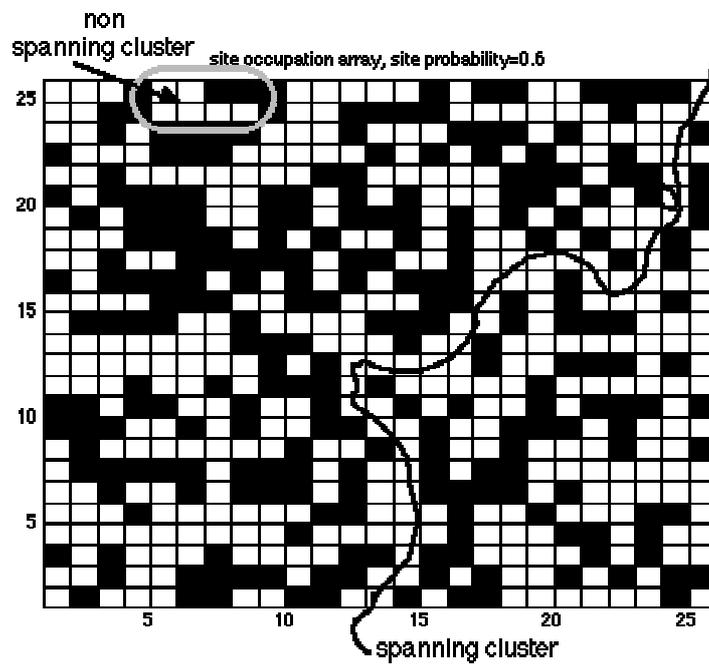
percolation

. Percolation

. Percolation bond percolation site percolation

[2], site percolation . 1 2

site percolation



1. 2 site percolation

3 $L_1 \times L_2 \times L_3$ 가 , P

1 , $1-P$ 0 . 1 , 0

가 , P
 [2].

Hoshen-Kopelman [3]

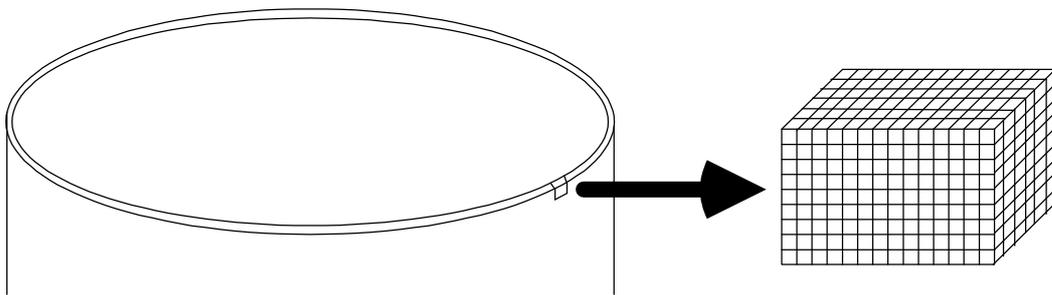
- (1) (0,0,0) 1 가
- (2) (X,Y,Z-1), (X,Y-1,Z), (X-1,Y,Z)
 (X,Y,Z)
- (3) (2), (X,Y,Z)
- (4)

가

가 Hoshen-Kopelman

3. (rim) pore

2



2.

1 μm

가

2

100()×300()×100() 3 1×1×1,
 2×2×2, 3×3×3, 4×4×4, 10×10×10

Monte Carlo

3 1×1×1
 , 10×10×10

가

Percolation

가

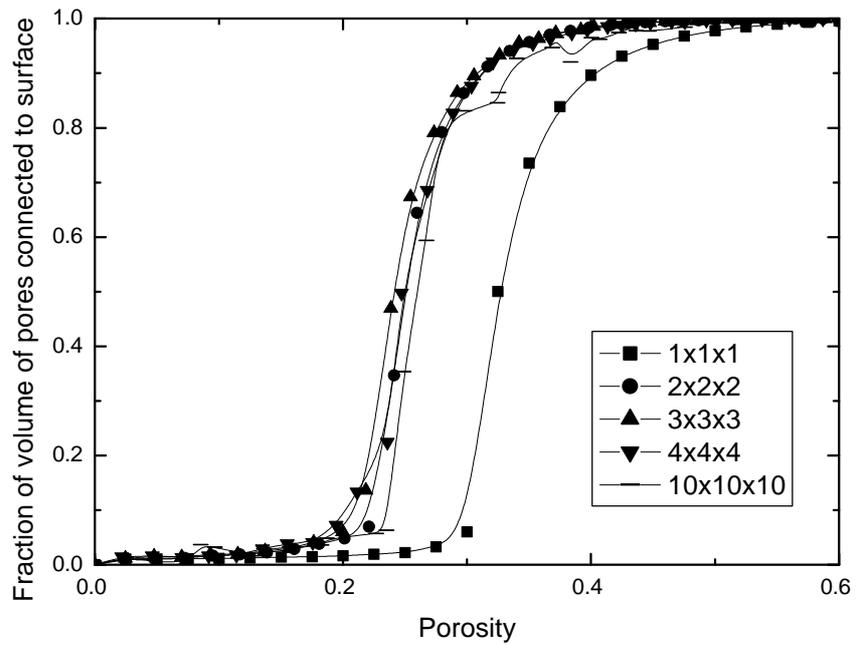
가 1×1×1

, 1×1×1

6 , 2×2×2

6

3



3.

3

가

150~200 μm

[4],

150 μm

0.5 μm

300()

×400()

×400()

1 μm

(2×2×2)

가

4.

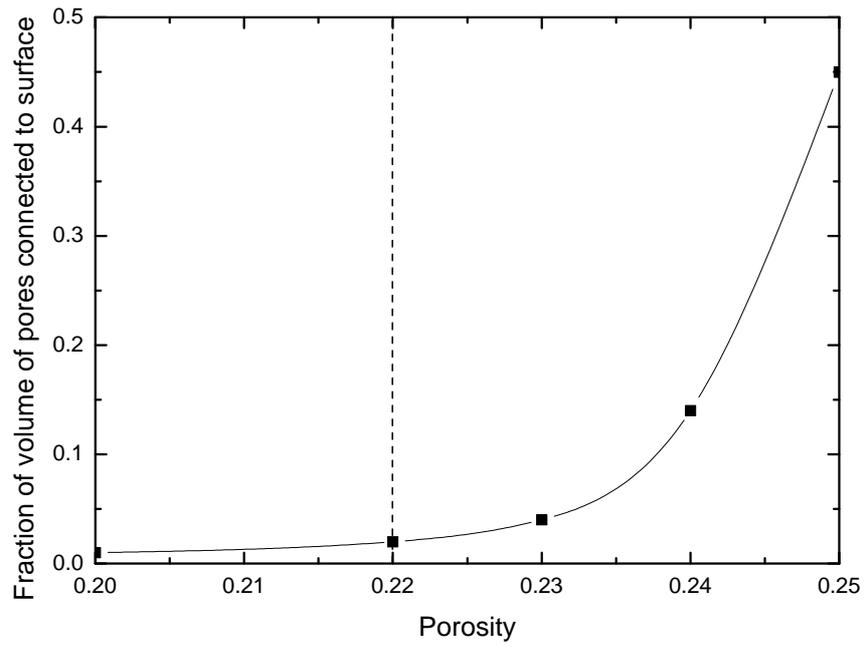
10~22%

[1,4].

22%

가

4



4.

가

22%

4

23%

가

가

가

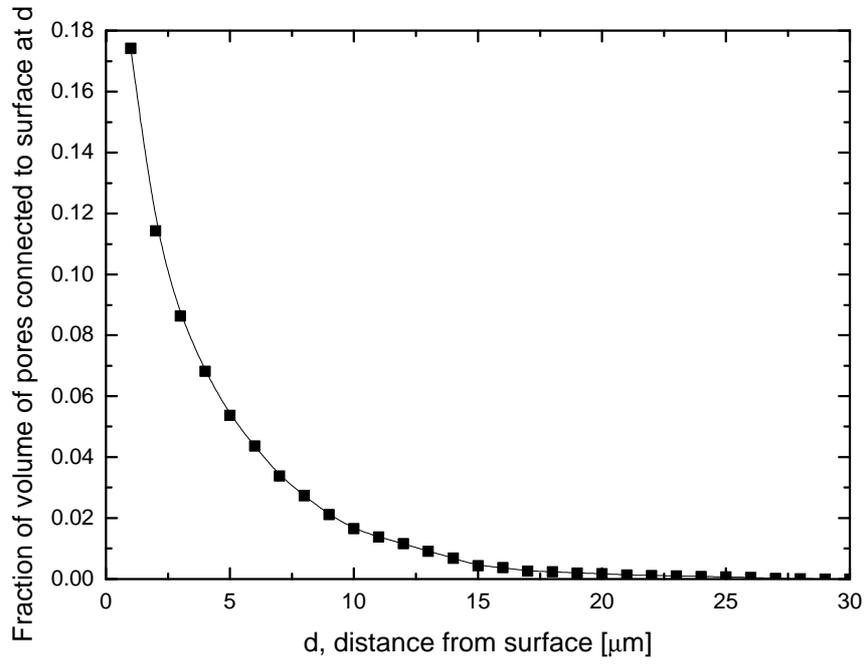
가

가

22%

5

20 μm



5.

5.

(rim)

가

percolation

22%

23%

가

가

22%

20 μm

- [1] J. Spino, K. Vennix, M. Coquerelle, "Detailed characterization of the rim microstructure in PWR fuels in the burn-up range 40-67 GWd/tM", J. Nucl. Mat., 231 (1996) 179.
- [2] Geoffrey Grimmett, "Percolation", Springer-Verlag, 1989.
- [3] <http://phycomp.technion.ac.il/~comphy/nir/percolation.html> .
- [4] S.R. Pati, A.M. Garde and L.J. Clink, "Contribution of pellet rim porosity to low-temperature fission gas release at extended burnups", Proc. Int. Topical Meeting on LWR Fuel Performance, Williamsburg, Virginia, USA, (1998) 204.