Study on the Characteristics of DUPIC fuel with powder treatments

Korea Atomic Energy Research Institute, Kweon Ho Kang*, Ho Jin Ryu, Sang Ho Na, Heung Soo Moon, Kee Chan Song and Myoung Seung Yang

1. Introduction

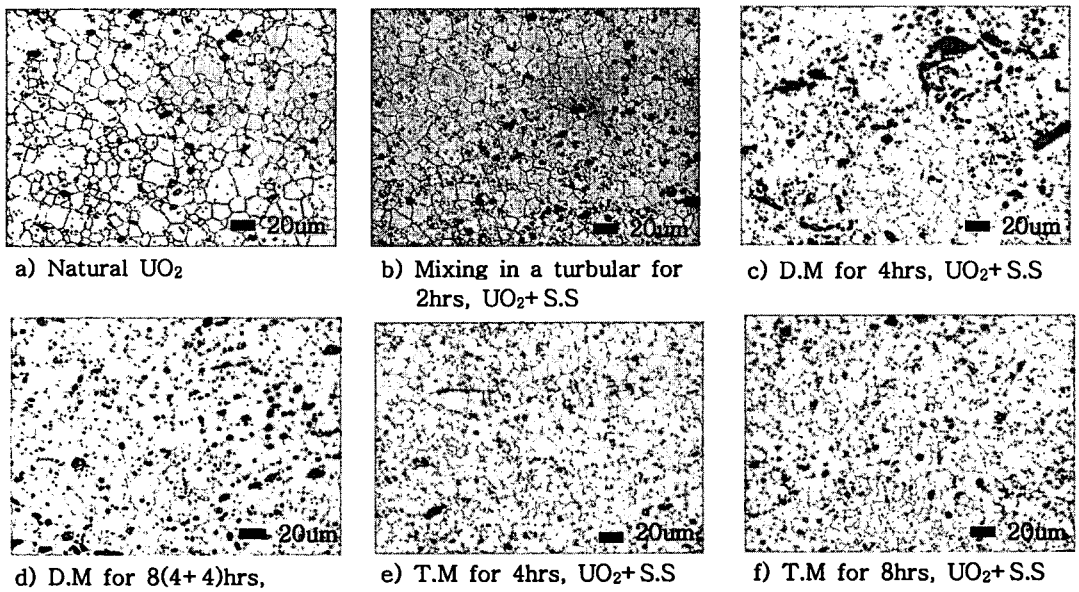
A new fuel cycle, called the Direct Use of spent PWR fuel In CANDU reactors (DUPIC), has received renewed interest recently as a PWR to CANDU synergistic fuel recycling option[1]. Taking advantage of the Korean nuclear reactor strategy of having both light water reactors (PWR) and heavy water reactors (CANDU) for electricity generation, the DUPIC concept as a alternative nuclear fuel cycle has been suggested. The spent PWR fuel can be burned again in CANDU reactors by a direct refabrication of CANDU -compatible DUPIC fuel which is fabricated by only mechanical and thermal processes without the separation of any sensitive nuclear materials, even fission products. The remnant fissile content in the spent PWR fuel is high enough to be reused in CANDU reactors.

Simulated DUPIC fuel provides a convenient way to investigate the DUPIC fuel properties and behaviour such as the thermal conductivity, thermal expansion, fission gas release, leaching, and so on without the complications of handling radioactive materials[2].

In this study, only six elements, which only form solid solution, as surrogates for the fission products was added to UO_2. We studied the properties due to a variation of the Solid Solution(S.S) amount, milling method, milling time and compacting pressure.

2. Result and discussion

UO_2 +S.S powders were decreased in their sintered density by an oxidation of the UO_2 powder because of the shock and friction by the zirconia ball. But, a high value of the



a) Natural UO_2 b) Mixing in a turbular for 2hrs, UO_2+ S.S c) D.M for 4hrs, UO_2+ S.S

d) D.M for 8(4+4)hrs, UO_2+ S.S e) T.M for 4hrs, UO_2+ S.S f) T.M for 8hrs, UO_2+ S.S

Fig. 1 Microstructure of sintered pellets of UO_2 and UO_2+S.S due to the milling time and milling method.

flow-ability of the UO_2 +S.S powder by a ball milling showed a higher value of the sintered density and a big grain size. Dynamic milling could produce much bigger sintered pellets in grain size, when compared to the pellets produced by a turbular milling. However, those pellets have a lower sintered density due to an oxidation of the UO_2 powder caused by a shock emitted when milling. The higher the amount of S.S, the lower the sintered density. The higher the compacting pressure, the higher the sintered density and the bigger the grain size. New dynamic milling and dynamic milling have to be undertaken for 8(4+4)hrs for a homogeneous micro structure. But, it is possible that a turbular milling for 4hrs could give a homogeneous microstructure.

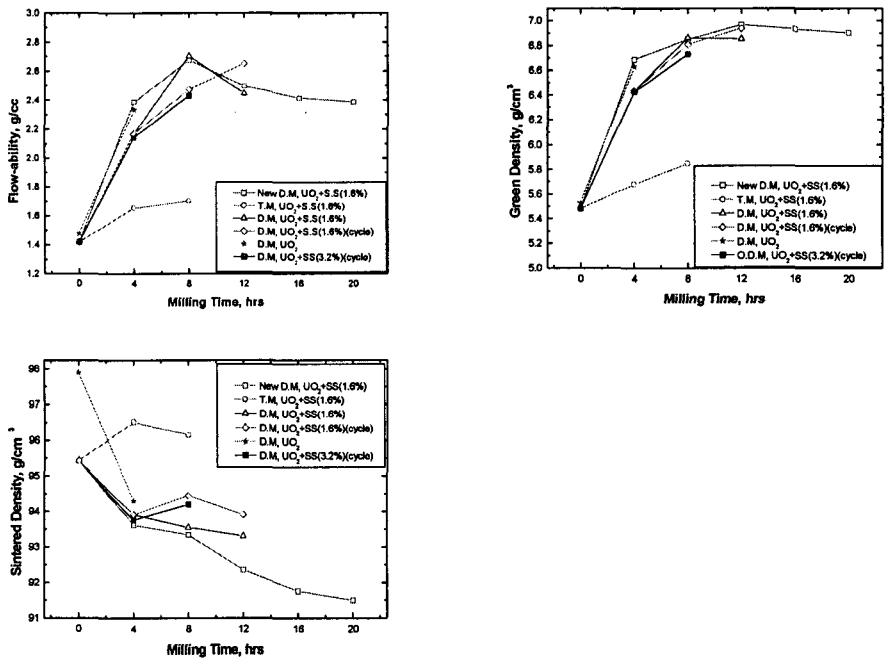


Fig. 2 Various characteristics of UO_2 and UO_2+S.S due to the milling time and milling method.

3. Conclusion

UO_2 and UO_2+S.S pellets have a lower sintered density due to an oxidation of the UO_2 powder caused by the milling. Turbular milling produced homogeneous sintered pellets in microstructure, but these pellets were small grain size, compared to the pellets produced by a dynamic milling.

Acknowledgements

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Reference

1. J.S. Lee et al., Global '93, seattle, Washington (1993)
2. K.H. Kang et. al., Metals and Materials 6: 583 (2000)