Narodowe Centrum Badań Jądrowych
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ŚWIERK

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Departament Badań Układów Złożonych (DUZ)

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Predicting oxide growth and corrosion resistance in Si-rich SiC fuel matrices fabricated by the reaction sintering process for high-power nuclear reactors during accidents

Abstract:

Although much emphasis is given to enhancing the safety performance while designing reaction-sintered SiC fuel matrices, oxidation behavior of these Si-rich SiC fuel matrices is an emerging area of research for the targeted innovative nuclear energy application. Predicting the oxide growth process and understanding the potential impact of excess Si on high-temperature oxidation are vital in ensuring fuel safety during the postulated accidental scenario. Using TGA, XRD, and SEM-EDX, the study tracks the oxidation process, highlighting excellent antioxidation properties in air up to 1400 ℃ associated with dense oxide formation in irregular thickness. The study reveals that the reaction-sintered SiC matrix possesses free Si about 10 wt.%. Unlike the Si-less matrix, the Si rich area promotes passive oxidation rate while preventing corrosive active oxidation mode in 1 ppm oxygen concentration at 1400 ℃. The excess Si within the SiC matrix may play a crucial role in improving the oxidation behaviors, and thus may positively affect the overall quality of the SiC fuel matrices. The findings of this research offer valuable insights to deconvolute the mechanism for oxide growth and will pave the way for a predictive design of SiC fuel matrix with improved resistance to oxidation under extreme conditions, facilitating fabrication technology for improved performance and durability by the reaction sintering method.

Serdecznie zapraszamy
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Bio:
Yosuke Nishimura – Ph.D. student at Nuclear Engineering and Management, the University of Tokyo. Winner of Akiyama Medal (Best student award) at the 30th International Conference on Nuclear Engineering (ICONE30), JSPS Research Fellow, Technical advisor at the Institute of Applied Energy (IAE).
Research area: Materials science, Nuclear materials, Monte Carlo simulation, HTGR.