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In-Situ TEM Studies on Nanostructured Ferritic Alloys (NFA) and Cr_3C_2@SiC-NFA Composites During Ion Irradiation

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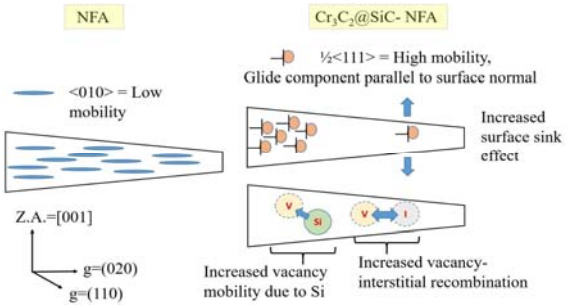
Abstract

This presentation will describe our work on the microstructural characterization and ion irradiation responses of a Fe-based nanostructured ferritic alloy or 'NFA' (Fe-9Cr-2W-0.2V-0.4Ti-0.3Y_2O_3) and a Cr_3C_2@SiC-NFA composite for fuel cladding applications. We have examined irradiation response at doses of 0, 1, 3, 5 and 10 dpa and temperatures of 300°C and 450°C using TEM equipped with in-situ ion irradiation capabilities at Argonne National Laboratory. Both the NFA and Cr_3C_2@SiC-NFA samples show significant dislocation density after 10 dpa at 300°C. However, the Cr_3C_2@SiC-NFA composite shows a significantly lower dislocation loop density and a smaller average loop size during the irradiation at 450°C as opposed to the NFA. At 300°C, microstructures of NFA and Cr_3C_2@SiC-NFA show predominantly 1/2<111> type dislocation loops. At 450°C, NFA show predominantly <100> type loops, however, Cr_3C_2@SiC-NFA composite is still predominant in ½<111> loops. This talk will discuss possible reasons for this interesting behavior based on the large surface sink effects and enhanced interstitial-vacancy recombination at higher temperatures. The additional Si element in the Cr_3C_2@SiC-NFA sample could have been an important factor in determining the dominant loop types.



Mechanism of irradiation of NFA and Cr_3C_2@SiC-NFA composites

Reference: Kaustubh Bawane, Kathy Lu, Xian-Ming Bai, Wei-Ying Chen, Meimei Li, *Materialia*, 7, 100412 (2019)

Biosketch

Kaustubh is a fourth year Ph.D. student in the MSE department working with Prof. Kathy Lu. His research is focused on processing, irradiation, high temperature corrosion of SiC and nanostructured ferritic alloys composites for nuclear applications. He has published 10 journal papers. He earned his Master of Engineering from the Indian Institute of Science, Bangalore, and Bachelors of Technology from College of Engineering, Pune in India before joining Virginia Tech for a Ph.D. in Fall 2016.