

Effect of Heat Treatment on the Irradiation Behavior of Monolithic U-Mo Fuels

by

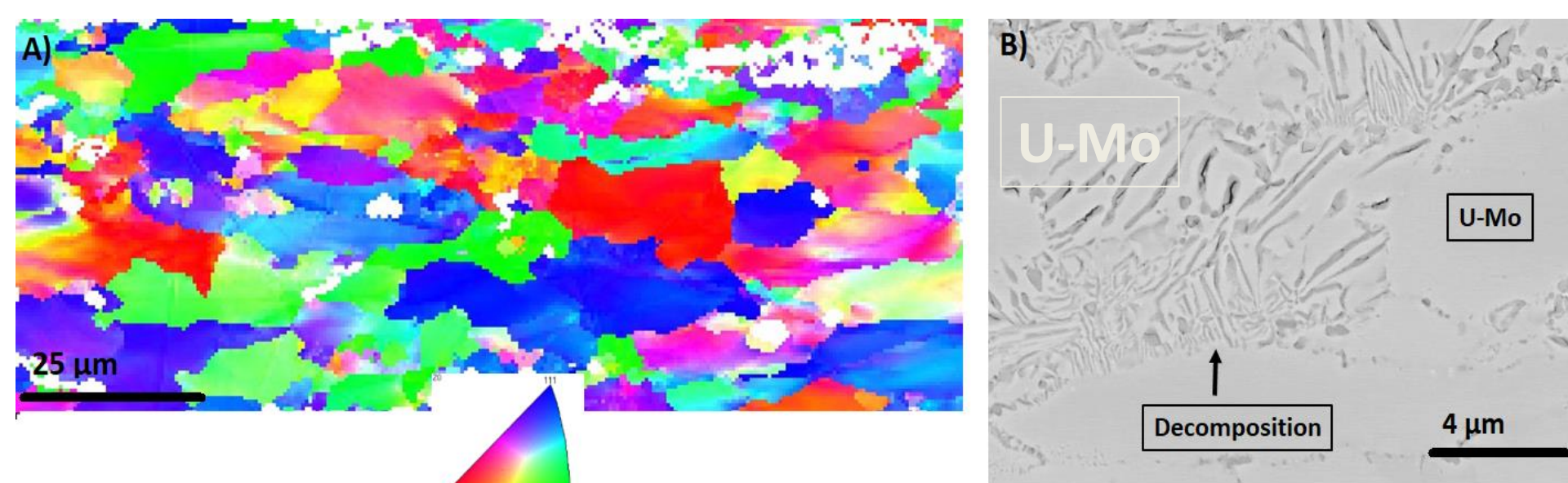
J. Jue, T. Trowbridge, J. Burns, F. Di Lemma, A. Winston, A. Robinson, D. Keiser, J. Giglio, and J. Cole
Idaho National Laboratory, Idaho Falls, ID 83415, USA

Abstract

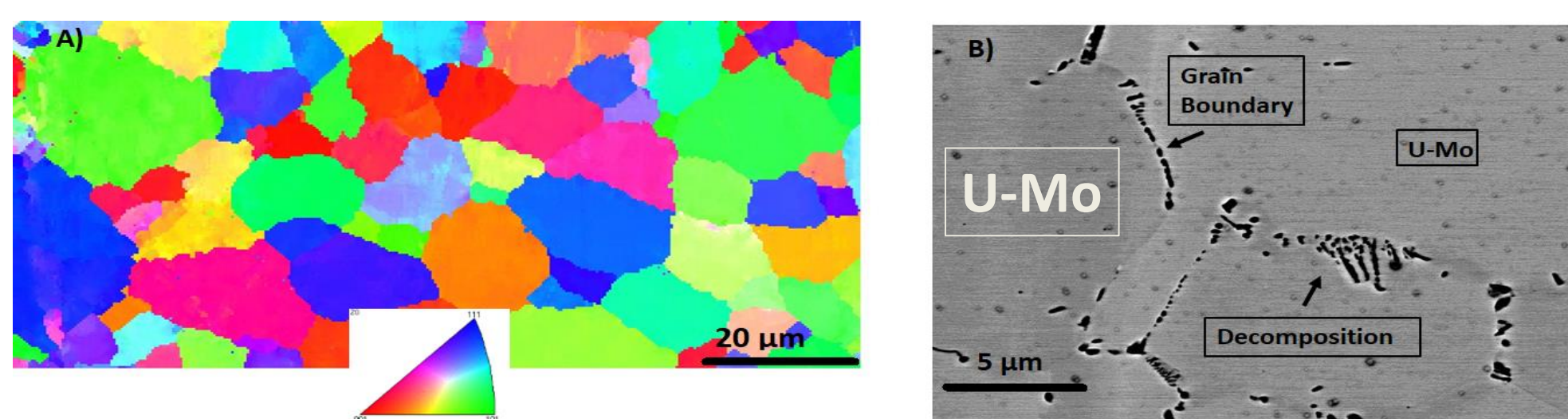
- The purpose of this study is to compare the microstructure of the irradiated MP-1 Vendor fabricated fuel plates to that of the Laboratory fabricated fuel plates.
 - One important difference in fabrication is the Vendor plates are annealed (heat treated) while the Laboratory fuel plates are not.
- Preliminary results indicate that the annealed Vendor fabricated fuel plates exhibit a larger grain size and a more homogeneous Mo distribution than the Laboratory fabricated fuel plates.
 - These characteristics positively impact fuel performance.
- Reverse transformation to gamma phase uranium is observed in both Vendor and Laboratory produced irradiated fuel specimens.
- Bubble formation initiates at grain boundaries and the low-Mo sublayer near the Zr/U-Mo interface of the annealed fuel plates.

Comparison of the Grain Structure of the MP-1 Un-irradiated Fuel Plates

Laboratory Fabricated Fuel Plate (without Heat Treatment)



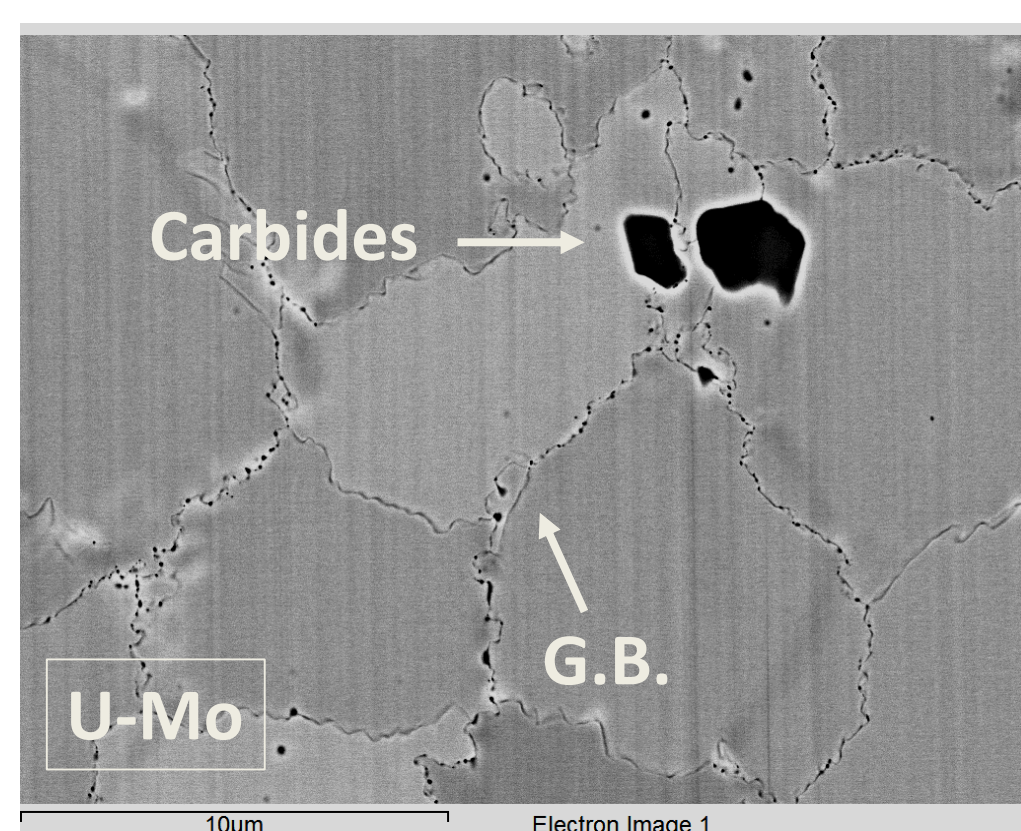
Vendor Fabricated Fuel Plate (with Heat Treatment)



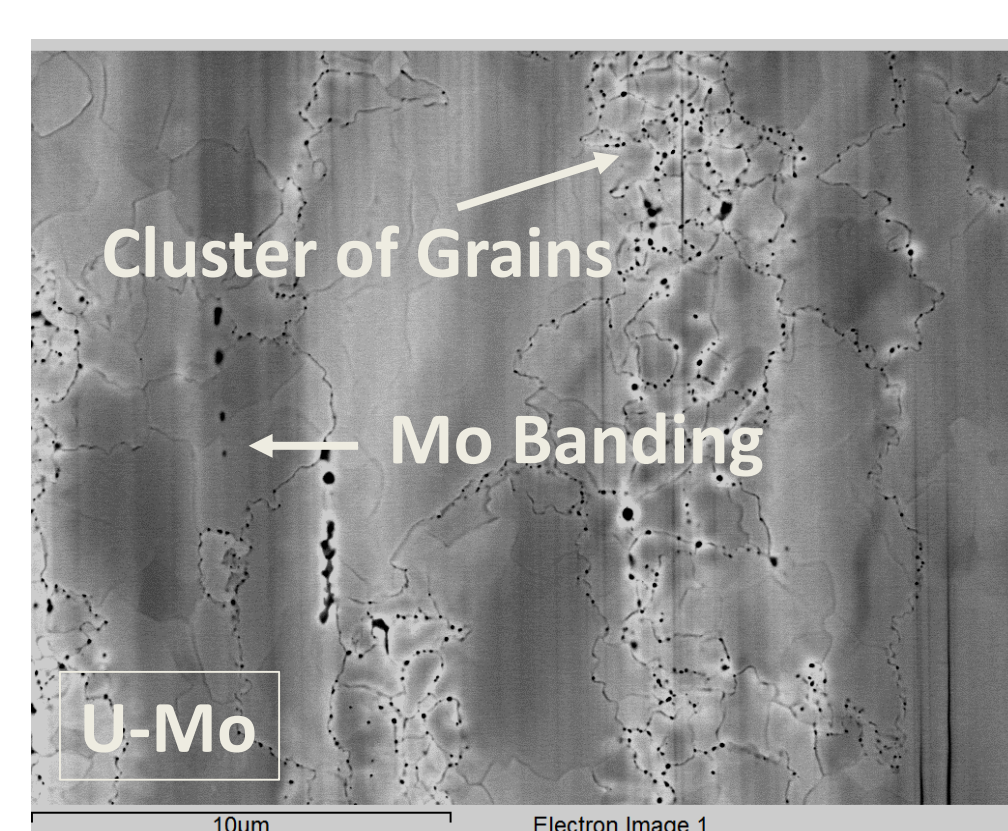
- Heat treatment fuel plates exhibit larger grain size and less gamma phase uranium decomposition in U-Mo.

Grain Structure of the MP-1 Irradiated Fuel Plates

Vendor Fabricated Fuel Plate (with Heat Treatment)



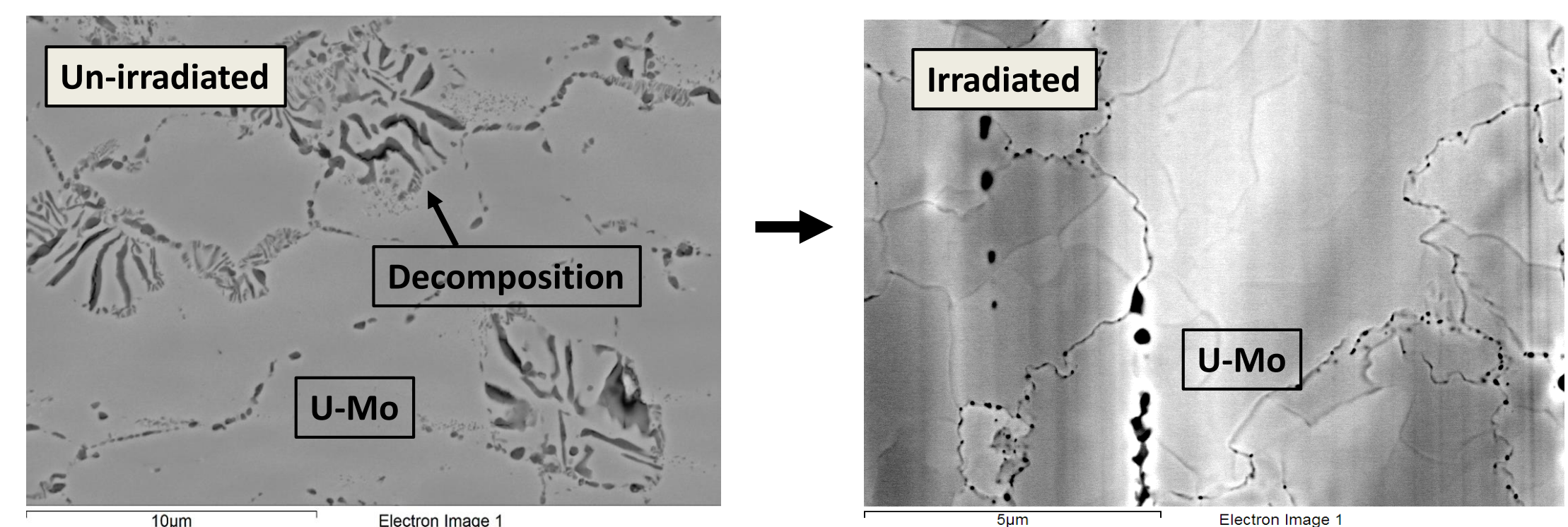
Laboratory Fabricated Fuel Plate (without Heat Treatment)



- Mo banding is still obvious in the Laboratory fabricated fuel plate.
- Clusters of micron-size grains were observed in the Laboratory fabricated fuel plate.

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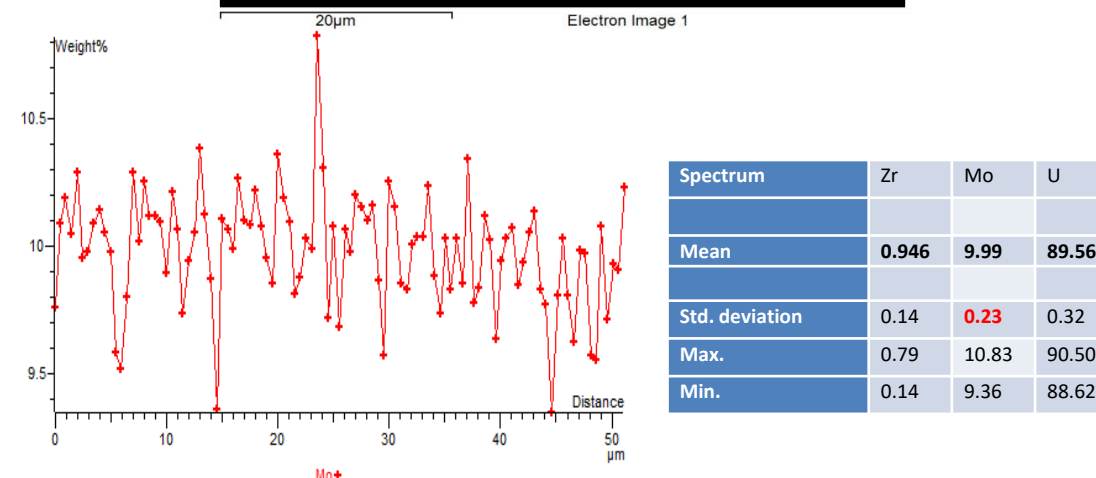
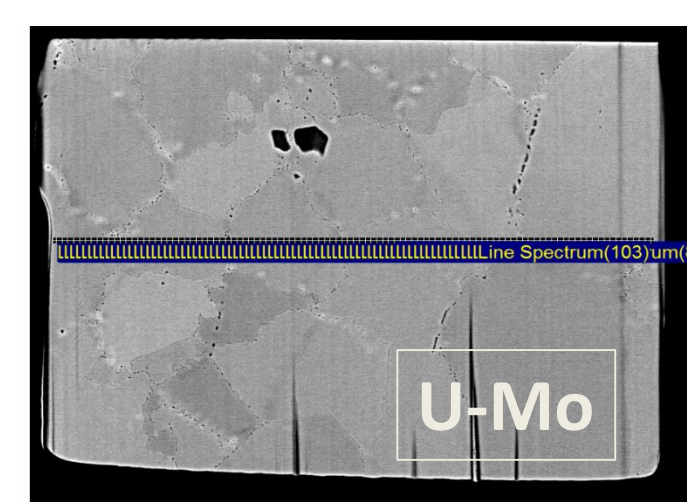
Reverse Transformation of Gamma Phase Uranium



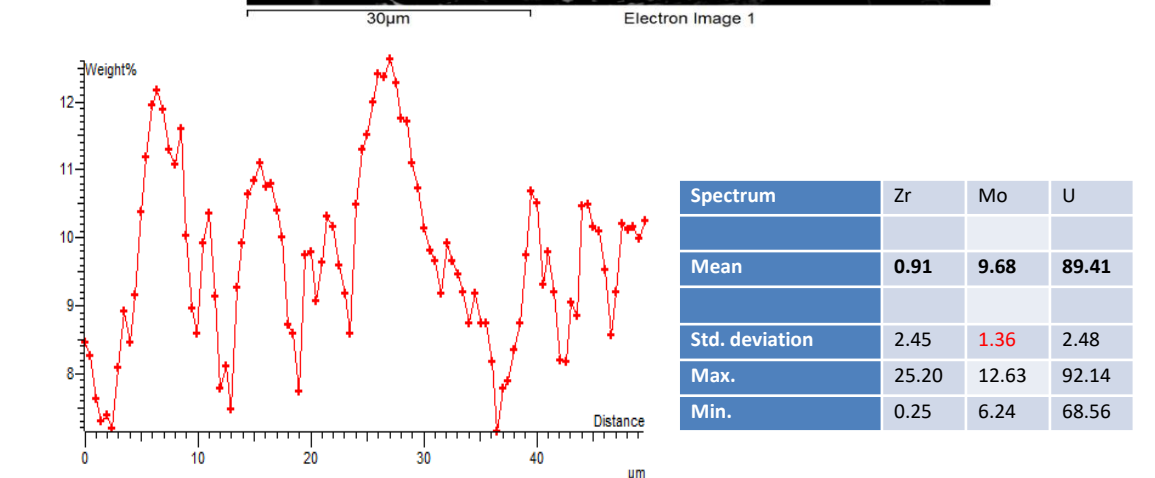
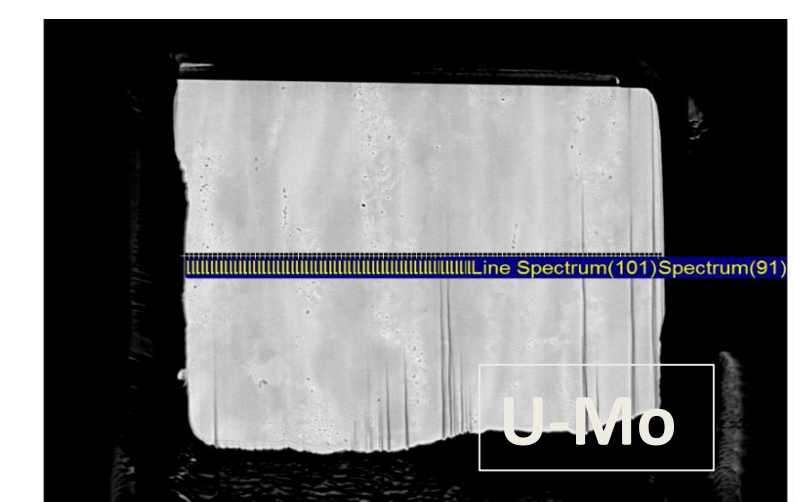
- After irradiation ($\sim 0.9 \times 10^{21}$ fission/cm³), the gamma phase uranium decomposition areas no longer exist. More prevalent in Vendor fabricated plates.

Mo Distribution in MP-1 Irradiated Fuel Plates

Vendor Fabricated Fuel Plate (with Heat Treatment)

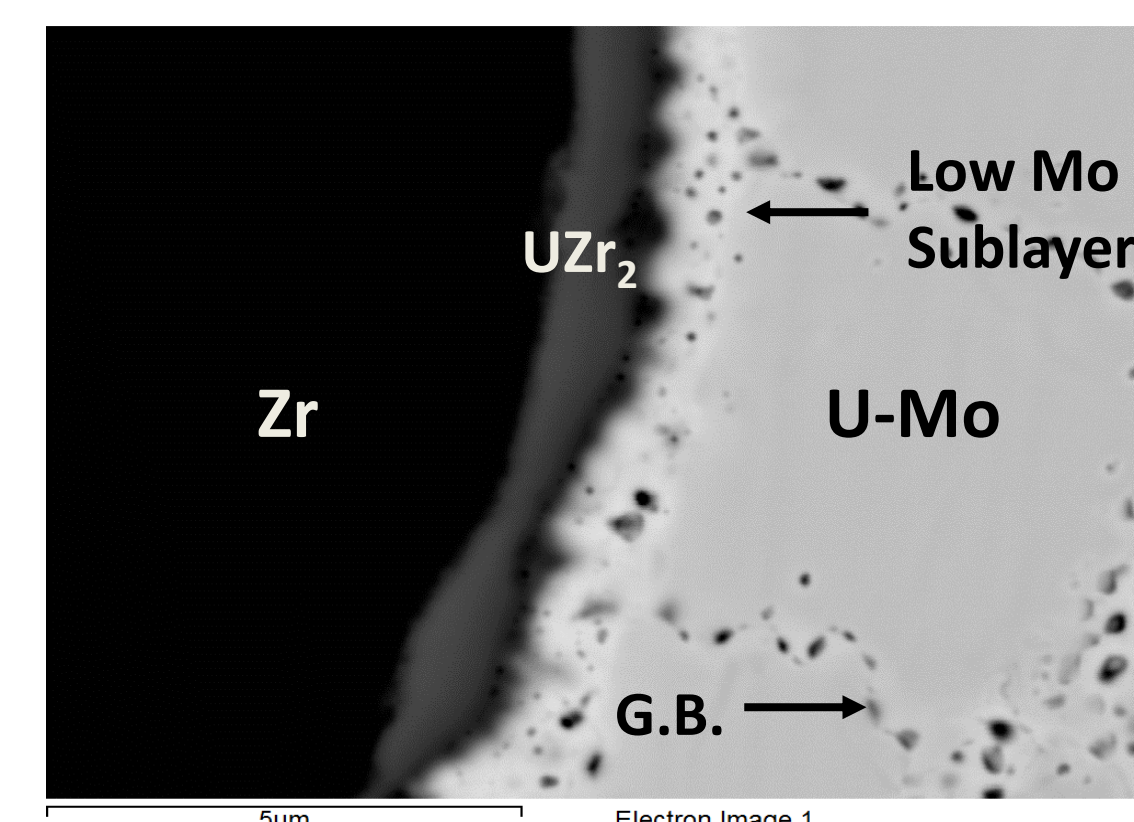


Laboratory Fabricated Fuel Plate (without Heat Treatment)



- Mo concentration is more homogeneous in the Vendor fabricated fuel plates due to pre-irradiation heat treatment.

Bubble Formation Initiates at Grain Boundaries and the Low-Mo Sublayer, near the Zr/U-Mo Interface



Conclusions

- ❑ Pre-irradiation heat treatment was employed in the MP-1 Vendor fabricated fuel plates.
 - ❑ With heat treatment, the U-Mo grain size increased, and the Mo distribution became more homogeneous.
 - ❑ Both observations positively impact the U-Mo irradiation behavior.
- ❑ Current PIE results support the benefit of pre-irradiation heat treatment in future fuel experiments