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Investigating the structure of Splat-Cooled Uranium and Uranium-Molybdenum alloys

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Splat cooled uranium. It has been used in a range of studies for around 50 years, coming into focus more recently as a source of 'glassy' or 'amorphous' uranium for super-conductor and electromagnetic experiments. But apart from a very cursory optical metallographic study in the early 60's[1,2], no characterisation work has ever been done on it.

The range of new techniques which have been developed since the initial study have significantly broadened the possible approaches, and have led to a truly novel study. Perhaps the most significant finding of the study has been the demonstration that using a splat cooling method with cooling rates of the order of 10^6K/s it has been possible to preserve the high temperature gamma phase at room temperature in pure uranium, something which was hither-to considered impossible. The gamma phase observed using EBSD were both intra-granular micrograins (typically siting along sub-boundaries) and inter-granular micro-grains. This correlates with XRD measurements made by the manufacturers. Given the relative strength of the XRD signal, it is thought that the gamma phase is found at the top surface of the splat (which, as the point of the most rapid cooling, is also the most logical position) and the majority removed during the electropolishing required to yield a surface of the required quality for EBSD analysis.

As part of the same study, the structure of a range of different uranium-molybdenum alloys (4, 11 and 15 wt%) have been splat cooled under similar conditions to probe the stabilising effects of the alloying element. The XRD data shows that the 4% Mo sample is a mix of $\alpha'+\gamma$, with the 11% effectively γ^0 and the 15% the expected pure γ phase. Following characterisation, these samples have been thermally aged to study the spinoidal decomposition which is often associated with uranium-alloy systems. The findings of this work are still ongoing.

[1] S. Isserow; Early work on rapidly solidified uranium , *Journal of Materials Science*, 1981,**16**, 3214-3215
[2]A. R. Kaufmann; Nuclear Metals Inc. (1963); Method and apparatus for making powder, US-3099041