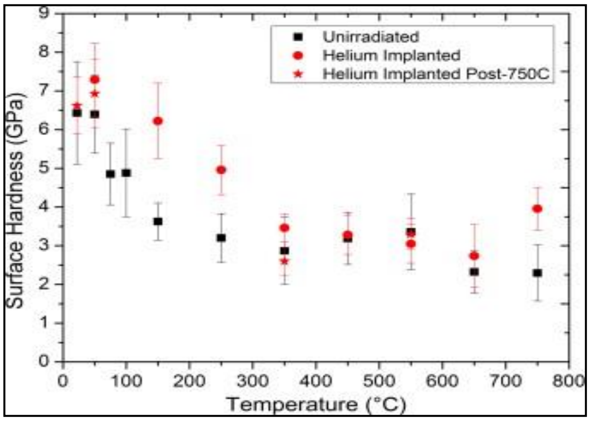
Micro Materials
Excellence in Nanomechanics

Nuclear Materials

Recent Publications from our customers

Micro Materials are pleased to present some of the recent research from our user base which highlight the use of the NanoTest in developing materials for Gen. IV reactors.



High temperature indentation of helium-implanted tungsten.

JSKL Gibson, SG Roberts and DEJ Armstrong.

This paper reports data gathered using the NanoTest Xtreme to 750 ˚C in vacuum on Tungsten (W) and He-implanted W.

This work has been done at reactor-relevant temperatures – to study the hardening mechanisms that may influence component brittleness in nuclear reactors.

Key Results:

- Helium implantation increases W hardness – the hardening effect of the He-damage decreases above 450 ˚C.
- After cooling back-down to room temperature, the W hardness was the same as when heated up.
- Measurement in vacuum was essential as W oxidises in air at >600 ˚C.
- Thermal drift reported below 0.01 nm/s at 750 ˚C. (better than most other nanoindenters at room temperature)

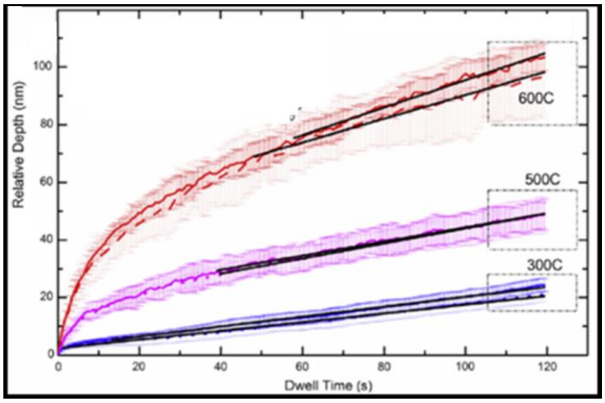
For the full paper see: Materials Science & Engineering A Vol. 625 (2015) pp. 380–384

Nanoindentation creep study on an ion beam irradiated oxide dispersion strengthened alloy

Z Huang, A Harris, SA Maloy and P Hosemann

Oxide dispersion strengthened (ODS) alloys are viewed as potential advanced structural materials for nuclear applications due to radiation tolerance and creep resistance.

In this study high temperature nanoindentation was used to examine changes in hardness and creep due to ion beam irradiation are studied at 25, 300, 500 and 600 ˚C.



Key Results:

- Ion beam irradiation is becoming popular to investigate the fundamentals of radiation damage but it has the drawback of a low damage depth. Nanoindentation is needed to investigate changes at this scale.
- All the previous nanoindentation data has been at room temperature.
- Not only does this study go beyond this but it reports very accurate data at low depth to 600 ˚C.
- To see subtle changes after irradiation excellent thermal stability was needed for creep testing at 200 nm depth.

For the full paper see: Journal of Nuclear Materials Vol. 451 (2014) pp. 162

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NanoTest Vantage

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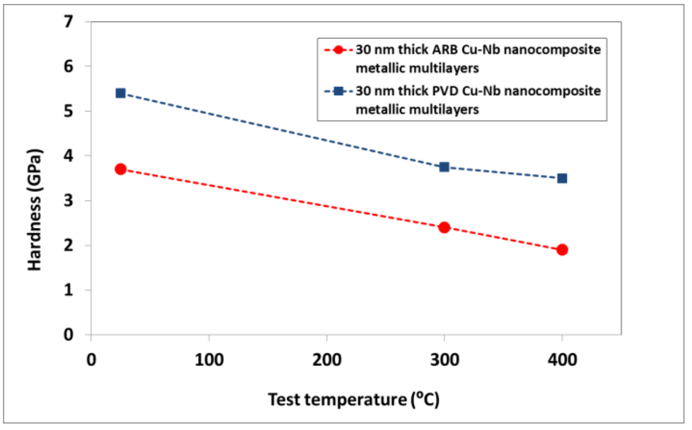

Optimum high temperature strength of two-dimensional nanocomposites

MA Monclús, SJ Zheng, JR Mayeur, IJ Beyerlein, NA Mara, T Polcar, J Llorca and JM Molina-Aldareguía

High temperature nanoindentation from 25-400 ˚C in purging chamber is used to reveal nano-layer size effects on the hardness of two-dimensional metallic nanocomposites (nanocomposite metallic multilayers, NMMs). These materials are more radiation-tolerant and structurally stable at high temperature than the individual components they are made from.

Key Results:

- Nanocomposite metallic multilayers made by Physical Vapour Deposition (PVD) have higher hot hardness than those made by accumulative roll bonding (ARB).
- Study reveals a critical layer thickness at which the material is more resistant to softening by elevated temperatures. This is due to a different deformation mechanism as the layer thickness changes.
- The paper shows extremely reliable high temperature data - the error bars in the hardness measurements are no higher at 400 ˚C than at 25 ˚C.

For the full article see: APL Materials Vol. 1 (2013), Issue 5, 052103

Key NanoTest features for testing nuclear materials

- **Ultra high stability high temperature testing to 850˚C – Proven high temperature testing for assessment of true in service properties**
- **NanoTest Vantage allows experiments to be performed in purged condition reducing the rate of sample oxidation**
- **NanoTest Xtreme allows experiments to be performed in a vacuum environment eliminating oxidation effects and extending the available temperature range even higher to 950 ˚C**

For more information on the techniques available for the NanoTest Vantage and NanoTest Xtreme go to www.micromaterials.co.uk or contact your local MML representative.

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