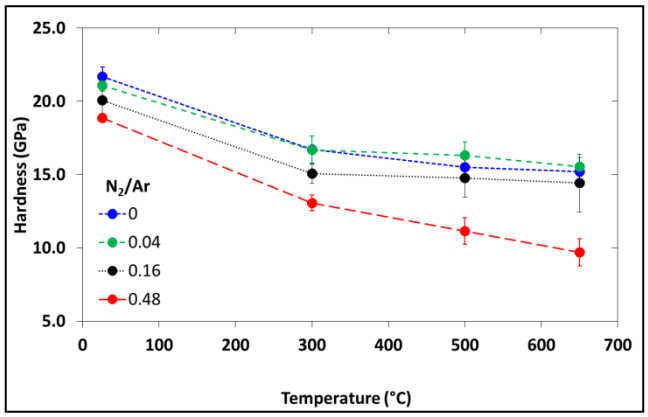
Micro Materials
Excellence in Nanomechanics

Wear Resistant Coatings

Recent Publications from our customers

Micro Materials are pleased to present some of the recent research from our user base which highlight the flexibility of the NanoTest as a tool for characterising novel wear resistant coating systems.



Mechanical properties of amorphous silicon carbonitride thin films at elevated temperatures

R Ctvrtlik, MS Al-Haik and V Kulikovsky.

Using a NanoTest system in a purging chamber the researchers reported on the temperature dependence of the hardness and elastic modulus of amorphous silicon carbide and silicon carbonitride films in the range 25-650 ˚C.

Key Results:

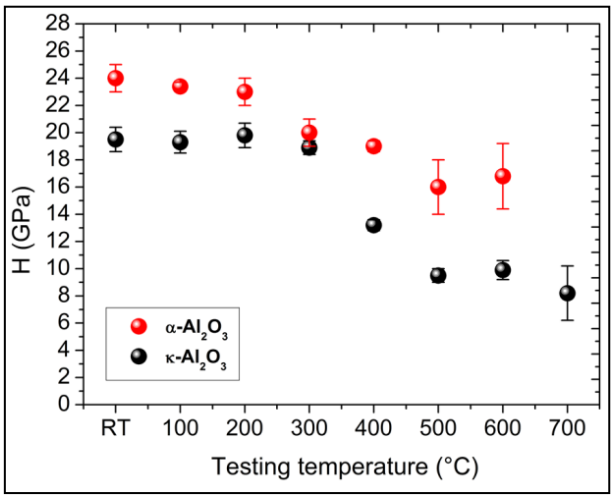
- **Hardness decreases significantly between RT and 300 ˚C and more slowly to 650 ˚C**
- **When the films were subsequently retested at RT they showed enhanced hardness and elastic modulus**
- **Enhanced properties were also seen after the samples had been annealed at 700 ˚C for 30 min**
- **Analysis of Raman spectra shows that this was due to enhanced short-range ordering in the films**

For the full paper see: Journal of Materials Science Vol. 50 (2015) pp. 1553-1564

Nanoindentation of CVD Al_2O_3 hard coatings at elevated temperatures

M Rebelo de Figueiredo, MD Abad, AJ Harris, C Czettl, C Mitterer and P Hosemann.

Rebelo de Figueiredo and co-workers have performed nanoindentation measurements on α-Al_2O_3 and κ-Al_2O_3 hard coatings at temperatures up to 600 and 700 °C, respectively. A NanoTest system in a purging chamber with c-BN indenter was used and measurements were performed in inert/reducing atmosphere (Argon + 5 % H_2 mixture).



Key Results:

- **A decrease of hardness and reduced modulus was observed for both coating systems as the temperature increases**
- **The κ-Al_2O_3 coating had lower hardness at room temperature and showed a larger reduction in high temperature hardness (see figure)**
- **The paper also includes a comprehensive overview of guidelines on how to perform nanoindentation measurements on hard coatings at elevated temperatures**

For the full paper see: Thin Solid Films Vol. 578 (2015) pp 20-24

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NanoTest Vantage

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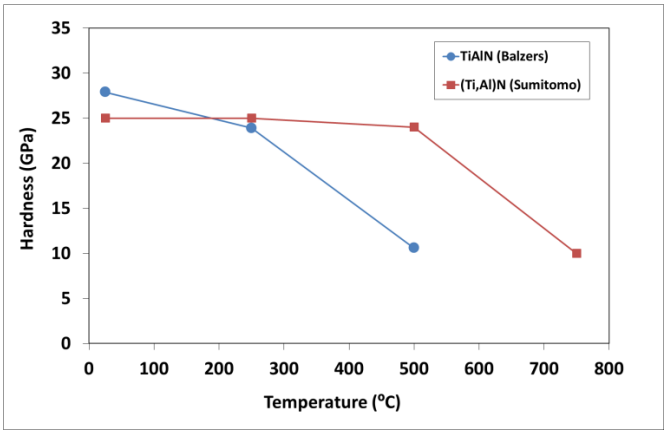

Progress in high temperature nanomechanical testing of coatings for optimising their performance in high speed machining

BD Beake and GS Fox-Rabinovich

This review article summarises over 10 years of collaboration between MML and McMaster University. It shows how two unique NanoTest techniques can provide information to improve coatings design not obtainable from room temperature nanoindentation testing.

Key Results:

- **Correlation between high temperature hardness from nanoindentation and life of coated tools in cutting "hard-to-cut" materials**
- **Correlation between nano-impact and tool life. Toughness and impact resistance is also critical**
- **Different cutting situations require different balance of high temperature hardness and impact resistance**
- **To design the best performing coating you need both techniques**
- **The NanoTest has the very high thermal stability (very low thermal drift) required to test reliably at 750 ˚C**

For the full article see: Surface and Coatings Technology Vol. 255 (2014) pp. 102-111

Key NanoTest features for testing wear resistant coatings

- **Ultra high stability high temperature nanomechanical testing to 750 ˚C – Proven for assessment of true in-service properties**
- **Nano-impact for high strain rate fatigue - Established correlation with results of macro scale machining tests**
- **Nano scratch and wear – System rigidity gives reliable measurements of wear depth and friction force even on hard rough samples**

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

Local MML Representative

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