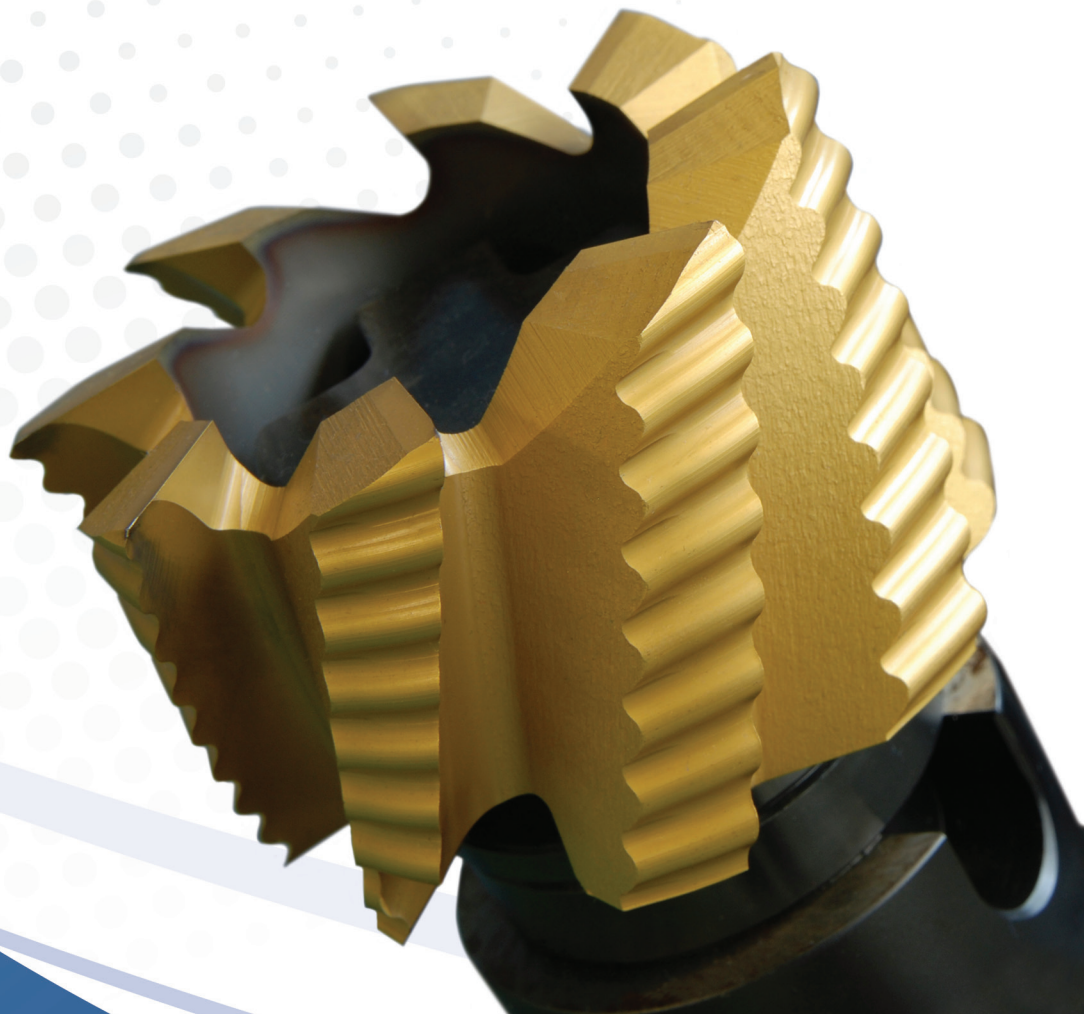


# NanoTest<sup>TM</sup> *Vantage*

THE NANOTEST VANTAGE: NEXT GENERATION  
NANOMECHANICAL TESTING FOR OPTIMISING  
WEAR RESISTANT COATINGS

- ▶ High speed machining
- ▶ Turning and milling
- ▶ Optimising resistance to abrasion/sliding
- ▶ Optimising resistance to fatigue/fracture
- ▶ Optimising resistance to fretting
- ▶ Wear-resistant coating



# Nanomechanical testing for hard coating applications

## Optimising coatings through rapid, rigorous testing

High speed machining puts huge stresses on tools during the cutting process. Optimizing their coating microstructure to deliver the correct combination of hardness and toughness will ensure that they perform – and keep on performing. But the wide range of conditions under which they will operate makes this a highly complex requirement.

## Real World tests

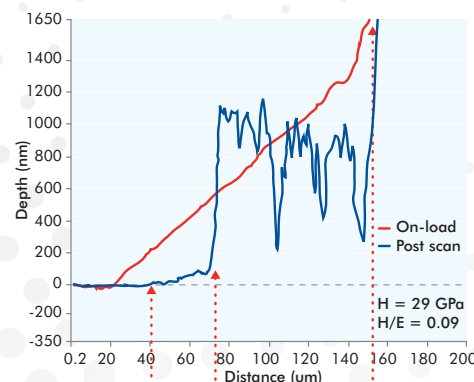
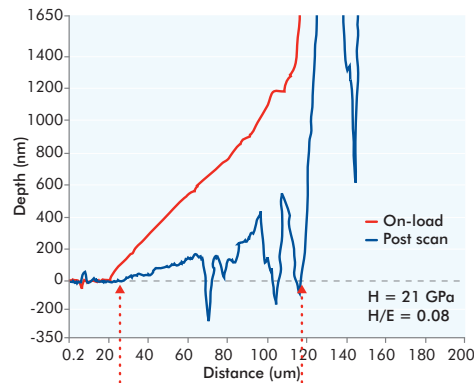
Performance factors such as oxidation resistance, thermal stability and hot hardness will need to be built in, depending upon the function hard coatings are required to fulfill. Coatings then need to be tested against wear factors such as friction, wear, oxidation, thermal cycling and adhesive interaction.

To test for all this diversity of conditions and factors would be impossible under normal macro-scale test conditions. But nanomechanical testing allows you to assess them all, by simulating real contact conditions, allowing you to evaluate the three primary and interlinked factors influencing the tool life of hard coated tools: plasticity, hot hardness and fatigue fracture resistance.

The savings in time and materials are massive, enabling engineers to design and manufacture new tools rapidly and competitively.

◀ The NanoTest Vantage can be configured with nanoindentation, nano-scratch, nano-impact and nano-fretting.

## Nano-scratch to evaluate tribological properties



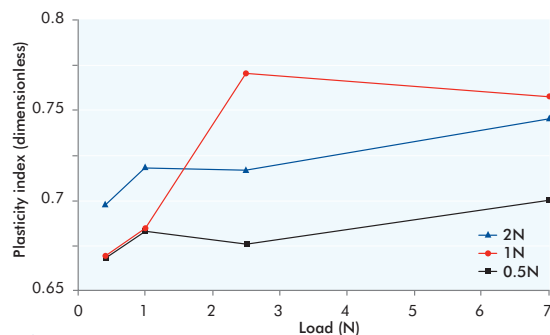
▲ Nano-scratch tests on Ti-Si-N nanocomposite coating and microscopic images of scratch tracks taken with the integrated NanoTest high resolution microscope. Their mechanical properties were determined by nanoindentation and their tribological properties were measured by nanoscratch testing. The nanoindentation showed that harder nanocomposites exhibited higher ratios of hardness to modulus (H/E) and that the H/E value clearly influences the nanoscratch behaviour as shown.



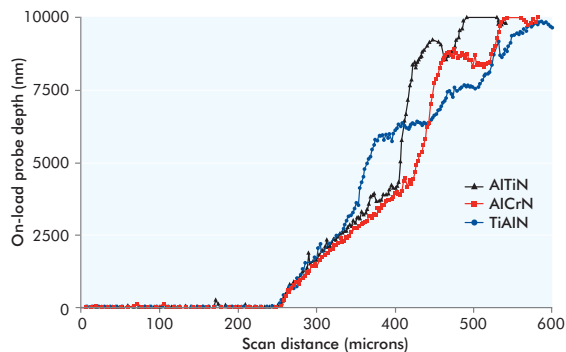
# Investigation of hard coatings utilising the wide load range of the NanoTest Advantage

## Carbide tool life

A combination of hardness and toughness is required for severe mechanical contact applications. Even subtle changes to the percentage binder and carbide grain size in cemented carbides can have a dramatic influence on tool life. It is the sub-surface mechanical properties that control the fatigue performance under highly loaded applications, such as high performance stamping. Therefore microindentation is used to determine the

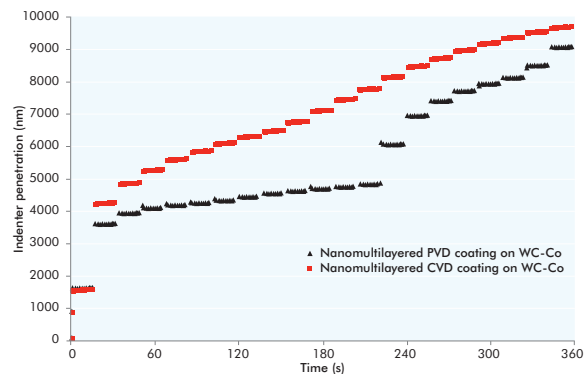


Variation in plasticity with load for commercial grades of WC-Co

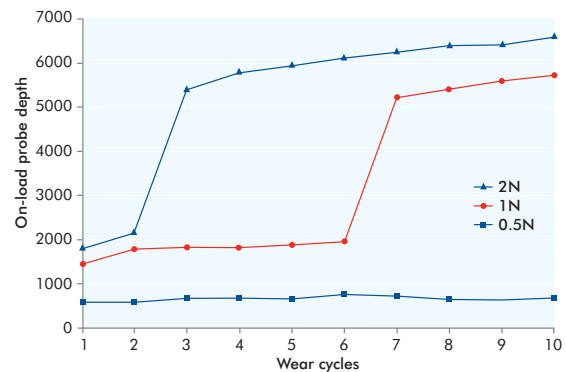


Ramped load scratches of AlTiN, AlCrN and TiAlN PVD hard coatings on carbide tools, with a 25  $\mu$ m scratch probe.

mechanical properties of different cemented carbides. The figure below shows how the plasticity index (the ratio of plastic energy to total energy in indentation) varies with indentation load. There is an excellent correlation between the microindentation data and wear rate. Lower plasticity results in chipping in wear tests and higher wear rate.



Differences in impact resistance of high performance nano multi layered coatings on carbide tools for high speed machining, courtesy of CEROC/Polytech Tours.



Repetitive constant load scratch tests for investigating wear on annealed AlTiN PVD hard coating.

# NanoTest Vantage: the user benefits

## High temperature measurements

Allows the testing of samples at temperatures up to 750°C, allowing evaluation of true 'in-service' mechanical properties.

## User friendly software

A simplified interface, while allowing full flexibility, makes the software easier to navigate and more intuitive - making it ideal for both new and inexperienced users.

## Industry-leading stability

The system has a dedicated environmental enclosure and a high thermal mass frame, ensuring ultimate instrument stability.

## High automatic throughput

The automatic scheduling facility allows maximum throughput without the need for user intervention, enabling the equipment to be used 24/7.

## Unrivalled flexibility

The NanoTest Vantage software offers a wide range of selectable parameters, allowing the user optimum flexibility of experiment design.

## Purpose-designed for experiments

A large working area between the motor stage and the indenter allows you to set up custom experiments.

Application/material	NanoTest advantages - hard coatings
High speed machining	Suite of relevant nano-/micro- test techniques utilising high strain rates and high temperatures
Turning and milling	Machine tool testing at real cutting temperatures, including repeated contact
Optimising resistance to abrasion/sliding	Nano-scratch module. Friction and wear testing at different temperatures and in lubricants.
Optimising resistance to fatigue/fracture	Patented nano-impact and contact fatigue module
Optimising resistance to fretting	Unique nano-fretting module
Wear-resistant coatings	A range of complementary tools for optimisation of coating processes: substrate-independent hardness, modulus, wear resistance, impact resistance – all at service temperatures

## Modular design to grow your research options

The NanoTest Vantage is a fully modular system that allows the user to configure the system to meet their individual needs and can be expanded at a later date to include further modules.

## Comprehensive after sales service & care

Our strong customer after sale care includes direct access to our expert engineering team who can help with your experiment design and custom software setup.

## Peer-collaboration and knowledge exchange

Many of our testing modules have been developed in response to the needs of our customers. You too can opt to be part of this collaborative approach.

## Cutting edge technology for enhanced research

We apply the very latest and most accurate technology in our NanoTest Systems which allows you to break through into new and pioneering research.

## Patented nano-impact and fatigue testing

This technique helps you design better materials or coatings for erosive protection, cutting tool, engine and other applications.

## Liquid cell facility

Allows the testing of a sample fully immersed in a fluid without indenter buoyancy problems associated with vertical loaded indentation.

## Load / partial-unload technique

This enables users to rapidly build up a complete profile of the variation of hardness and modulus with depth.

## Wide load range 10 $\mu$ N - 20N

With our micro and nano load heads you have a wide range of loads to choose from which adds to the flexibility of use for the system.

## FIND OUT THE FULL STORY

This has been a brief appraisal of the NanoTest Vantage's operating capabilities. To find out how one of the new generation models could transform your testing capabilities, get in touch and we can provide a detailed analysis of how it could benefit your operation.

To see the NanoTest Vantage in action (either at our UK headquarters, through one of our worldwide distributors or through a videolink) running test experiments that have relevance to you, again, just get in touch and we will do the rest.



Excellence in Nanomechanics

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