



Ebatco Nano

A Bimonthly Newsletter

Vol. 10 | Issue 01
Jan./Feb. 2020

Nano Brief

In 2020, Ebatco will have a booth at several upcoming seminars, society meetings, and trade shows with more to be announced later.

Ebatco will be exhibiting at these upcoming events:

- February 19th, ASM MN Chapter Whole-Day Seminar, Hennepin Technical College, Brooklyn Park, MN
- March 1st – 5th, Pittcon 2020, Booth #2536, McCormick Place, Chicago, IL
- April 18th – 23rd, SVC TechCon 2020, Booth #809, Hilton Chicago, Chicago, IL
- September 14th – 17th, IMAT 2020, Booth #1123, Cleveland, OH
- October 27th – 29th, MD&M, Booth #1340, Minneapolis Convention Center, Minneapolis, MN
- November 15th – 19th, ISTFA 2020, Booth #819, Pasadena Convention Center, Pasadena, CA

Please stop by our booth to discuss the incredible world of surface sciences, nanotechnologies, nanomaterials, and nano/micro scale material and device characterization with our staff scientists. We hope to see you there!

Ebatco

In order to better support the material analysis needs of our customers, Ebatco has acquired an Anton-Paar Revetest Scratch Tester (RST). The test system is capable of carrying out scratch tests under ramp or constant load force regimes, under pre-selected scratch lengths, and other control parameters automatically once it is programmed. The instrument is able to sense and measure testing conditions in real time such as normal force, friction force, vertical displacement, lateral displacement, and acoustic emission. From these parameters, comprehensive information about a material's mechanical, tribological and scratch properties can be characterized. Commonly characterized properties include microhardness, friction coefficient, wear resistance, critical load of coating interfacial failure, and scratch resistance. The test system is able to cover a wide range of loads for indentation, scratch, friction and wear testing.

The system is capable of applying loads of up to 200 N, and move a maximum displacement length of 70 mm under a speed up to 600 mm/min.

The Rvetest RST is a great choice for hard and thick coatings' mechanical, tribological and interfacial adhesion investigations. It can perform tests in compliance with ASTM C1624, ISO 20502 and ISO EN 1071 Standards.



The Anton-Paar Revetest RST Scratch Tester.

Case Study

Scratch Interfacial Adhesion Failure of TiN Coatings on Steel Substrate

Ceramic coatings are incredibly important to the worlds of machining, medical devices, and consumer electronics. Hard ceramic coatings protect surfaces such as the cutting edge of tools or complex surfaces in medical implants from frictional wear. These coatings can also be inert enough to protect valuable materials from corrosion, oxidation or exposure to harsh environmental conditions. The ceramic coating studied here is titanium nitride, or TiN. TiN is prized for its hardness, easy deposition methods, and its yellow-gold like appearance. The method used to deposit TiN onto a substrate can dramatically affect the coating's adhesion strength; and less than adequate adhesion to the substrate will result in a coating failing much sooner than expected.

In order to quantify the adhesion strength of a TiN coating on steel specimen, an instrumented scratch test method was used. This scratch test was carried out on a Revetest Scratch Tester manufactured by Anton Paar. During the scratch test a sharp conical probe, made of diamond, is being dragged across the sample surface under an increasing normal force. The diamond probe is progressively penetrating into the coating. Eventually, the coating shows cracking, chipping or delamination. The minimum load at which the coating separates from the substrate is called the critical load of coating interfacial adhesion failure. This critical load makes it possible to quantify the adhesion strength of the coating itself or compare adhesion strength among coatings.

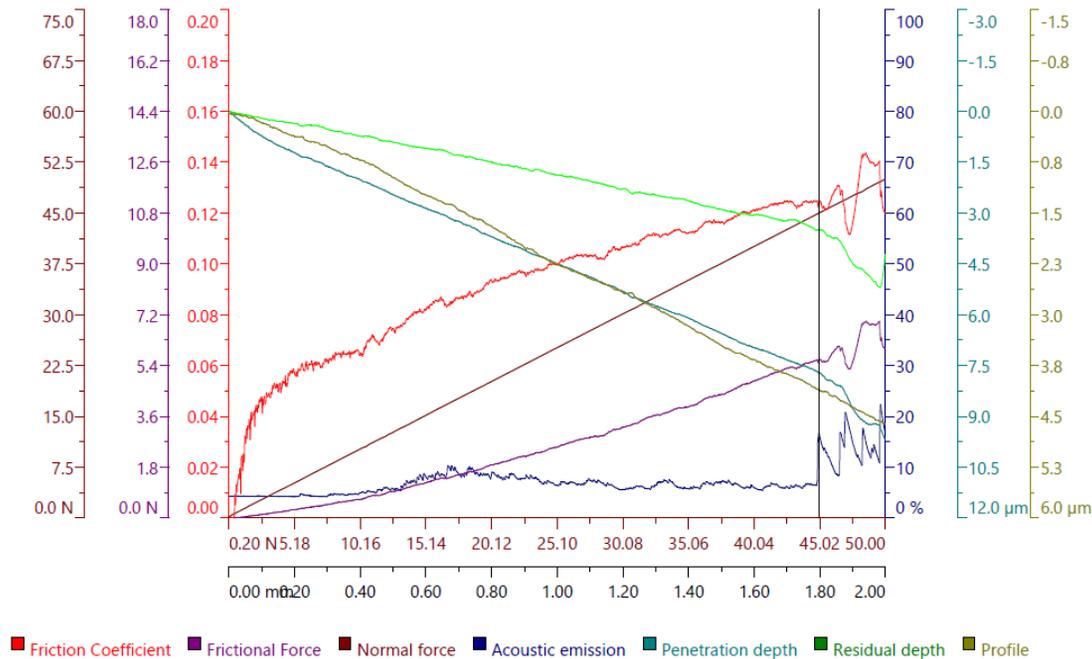


Figure 1. Scratch test curves of the TiN coating on steel substrate. The black vertical line marks the critical point of coating interfacial

adhesion failure.

There are several ways to identify critical loads when performing scratch tests. The most common techniques involve looking for sharp changes in acoustic emission, scratch coefficient of friction, penetration depth, or residual depth signals and relating that to optical microscopy images. Figure 1 shows the scratch test data obtained on the TiN coating on steel substrate specimen. From Figure 1, it can be seen that there are small slope changes in the coefficient of friction and acoustic emission curves starting at 13.01 N of normal force. This indicates some type of failure event may have occurred. Optical microscopy image, as shown in the inset of Figure 2b), confirms that the failure event is cracking along the outside edges of the scratch track. This cracking is a cohesive failure within the coating; the coating itself is still adhered to the substrate. At 44.95 N of applied force though, significant changes in the acoustic emission, coefficient of friction, penetration depth and residual depth signals are obvious. This points to a major failure event, and is proved by optical microscopy. As shown in Figure 2c large sections of the coating has chipped off and some of the steel substrate is exposed. This is coating delamination event and the normal force at the starting point of the event is the detected critical load of coating interfacial adhesion failure.

Scratch testing is a readily-available technique that can be used to evaluate coating interfacial adhesion strength and to study failure mechanisms of coating/substrate systems. In general, the higher the critical load of coating interfacial adhesion failure is, the higher the coating interfacial adhesion strength is, assuming the coatings have similar mechanical properties and thickness.

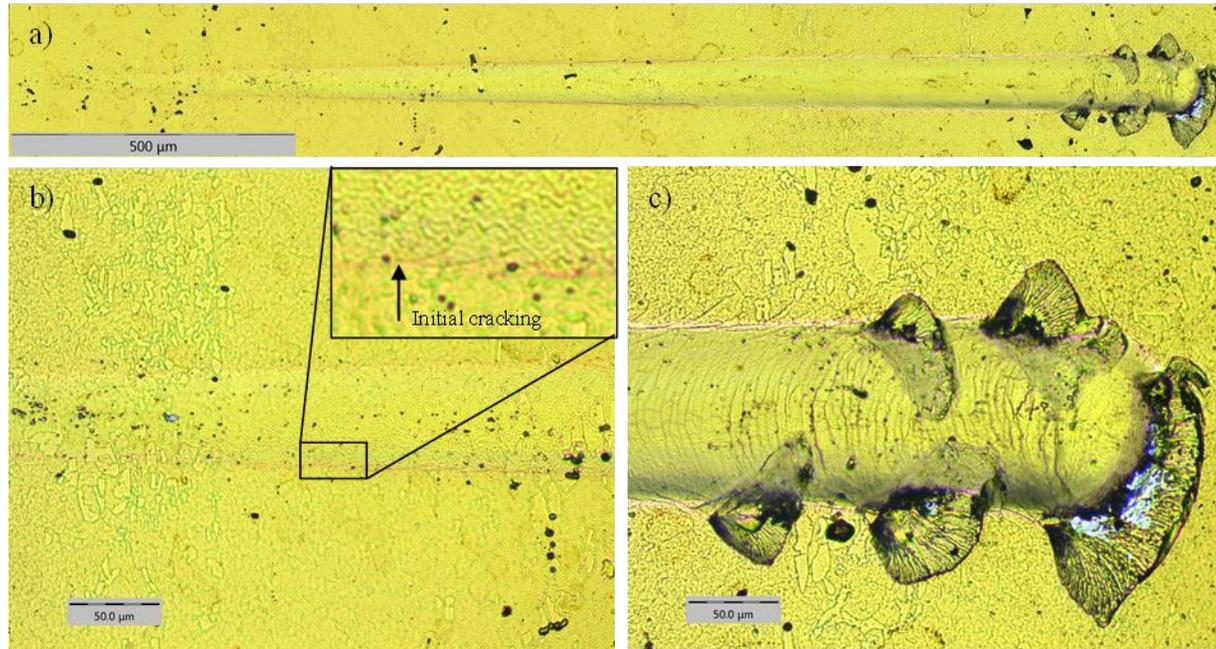


Figure 2. A 2 mm long scratch made on a titanium nitride (TiN) coating on steel substrate specimen imaged using a 20x objective lens: a) the entire scratch track, b) zoom in of the onset of cohesive failure/cracking, and c) zoom in of interfacial adhesion failure.

To subscribe or unsubscribe to this newsletter, contact info@ebatco.com.

Ebatco, 10025 Valley View Road, Suite 150, Eden Prairie, MN 55344
+1 952 746 8086 | info@ebatco.com | www.ebatco.com