



Ebatco Nano

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Nano Brief

Nanotechnology could be used to overcome the challenge of cancer therapy resistance. Thousands of people die every year from cancers that have returned and developed a resistance to previous treatments. Researchers at the University of Waterloo have discovered that the PI3K/AKT kinase enables the cancer cells to become resistant to treatment. By delivering an inhibitor to the PI3K/AKT kinase, the cancer cells will no longer be able to adapt to treatment. The challenge lies in combining the treatment drugs and inhibitor in such a way that they are both active in the cancer cell simultaneously. Bioengineers at Harvard Medical School were able to use supramolecular chemistry in order to incorporate both the drug and inhibitor into a stable nanoparticle capable of targeting cancer cells. This strategy ensures that the resistance to therapy never has a chance to develop and could potentially save countless lives.

Ebatco

As we continue to grow our business we have hired on new talents to expand our marketing programs and testing lab services. Please join us to welcome our three new additions to our marketing and technical team: Mr. Jim Spaight, Mr. Jimmy Taylor, and Mr. Shilin Sun.

Mr. Jim Spaight graduated in spring 2016 from Michigan Technical University with a degree in applied physics. His undergraduate research was spent analyzing the collision coalescence of cloud particles. He is excited to apply physics into industrial applications.

Mr. Jimmy Taylor has a degree in Materials Science and Engineering, with a specialization in Biomaterials and Polymers and a Minor in Sales Engineering from the University of Florida in Gainesville, FL. During his time in college, he worked in a Biomedical Engineering laboratory testing mechanical properties of biomimetic hydrogel tissue scaffolds for post-injury nerve regeneration tendency studies. He is extremely excited to use his combination of technical and interpersonal skills to take on his new role as Applications Associate at Ebatco!

Mr. Shilin Sun is a senior at University of Illinois at Urbana-Champaign majoring in physics. He has worked in automobile

manufacturing as supply quality management intern, while having related experience in digital video production. Tasting the coolness of nanotechnology as an intern during this summer, he will direct a video introducing and highlighting Ebatco.

Case Study

For hardness testing via nano/micro indentation, any cracking caused by sharp indenter tip and excessive load is undesirable and will lead to questionable data. However, such phenomenon and capability has been proven to be very useful in evaluating one of the critical mechanical properties of materials: fracture toughness. Fracture toughness is a measure of the materials ability to resist crack propagation and fracture under stress. Commonly used methods for evaluating fracture toughness of materials include bending, tension and impact tests of a specimen with a sharp crack or a defined notch. As regulated and recommended by many ASTM and international testing standards, these methods require the specimen with sufficient thickness and dimensions to ensure measurement validity. In many industrial and technical applications that involve small volume of materials, however, these requirements could not be practically met, for example in thin films, coatings, welds and miniaturized devices. The unmet needs by the conventional fracture toughness measurement methods have offered an excellent opportunity for the nanoindentation based techniques that are developed for mechanical characterization of small volume materials at nanoscale. Benefited from the established model and in-situ scanning probe microscopy (SPM) imaging capability, fracture toughness measurement via nanoindentation has become a preferred technique for in-situ and small-volume fracture behavior study of materials.

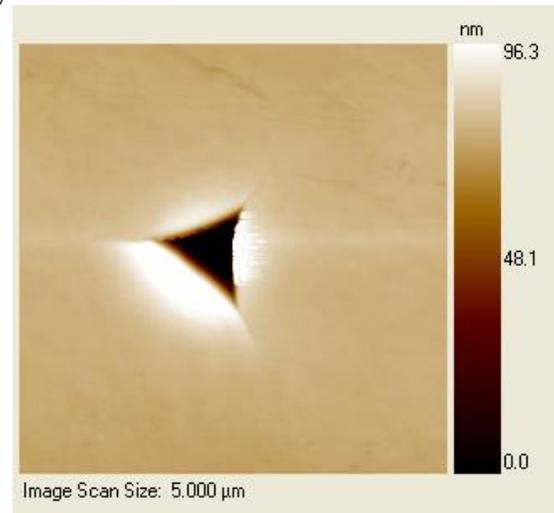


Figure 1. In-situ SPM image of an indent with cracks propagating from each of the corners for fracture toughness

To measure fracture toughness of small volume of materials, a relative high load is chosen for a nanoindentation routine with the goal

of creating cracks at the corners of the indent. Then the indented surface is imaged using the nanoindenter's in-situ SPM imaging function to capture the fine features of corner cracks of the indent as shown in Figure 1. The fracture toughness of the material is calculated using the following equation:

$$Eq. 1 \quad K_c = \alpha \left[\frac{E}{H} \right]^{1/2} \left[\frac{P}{c^{3/2}} \right]$$

Where K_c is the indentation fracture toughness; E is elastic Young's modulus, H is the hardness, P is the peak load and c is the average crack length from the center of the indent to the tips of the cracks. The constant, α , is a value related to the tip geometry and its values are known for cube cornered, Berkovich and Vickers tips.

Very conveniently, the hardness values required for determining the fracture toughness can be easily measured by using a smaller load and performing the normal nanoindentation test without causing any cracks. The Young's modulus is derived from the reduced elastic modulus determined through nanoindentation and the Poisson's ratio of the material. The crack length is measured from the center of the indent for all formed cracks using imaging software. Table 1 presents indentation fracture toughness values of a few specimens made of different materials using nanoindentation method.

Table 1 Fracture Toughness Determined Using Nanoindentation Method

Specimen	Load (mN)	H (GPa)	E (GPa)	Crack Length (m)	K_c (MPa*m ^{1/2})
Gelatin Capsule	7.5	0.33	6.70	4.08E-06	0.13
Fused Quartz	8.0	9.52	71.96	1.06E-06	0.64
Silicon Nitride	16.0	12.69	188.48	1.17E-06	1.57
Silicon Wafer	3.0	10.69	142.88	5.11E-07	0.96

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