

**Dr. Dehua Yang, FASM**  
**President**  
**Exponential Business and Technologies Company (Ebatco)**  
**Eden Prairie, MN**  
**Trustee (2023-2026)**



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Dr. Yang has a Ph. D. degree in Physical Chemistry, an M. S. and a B. S. degree in Physics. Dr. Yang has authored/co-authored more than 60 peer-reviewed publications on nanoscience and nanotechnology, tribology and surface science and engineering-related topics. He is a co-inventor of 7 issued US patents. He has given more than 80 presentations including 20 invited talks at research institutions and scientific conferences. The products he designed and managed at Hysitron, including the nanoTensile 5000 and 3D OmniProbe, won the 2007 Micro/Nano 25 Award and 2005 Nano 50 Award, respectively.

Dr. Yang has held leaderships and memberships at various technical professional societies. He is currently the Chair of the Handbook Committee and a board member of Minnesota Chapter of the ASM International. He is a board member of the Twin Cities Section of STLE and was a technical editor for Tribology & Lubrication Technology. In recent years he has served as the Chair for the Technical Book Committee of ASM International, the Chair of Minnesota Chapter of the ASM International, the President of Minnesota Microscopy Society and the Chairman of Twin Cities Section of STLE. He has also served many times as a US National Science Foundation grant review panelist, journal referee, international conference organizer and session chair.

Dr. Dehua Yang is a Fellow of ASM International and a renowned, award-winning materials scientist, accomplished corporate executive, and founder of a successful nanotechnology development and services company. He has over 30 years of experience spanning critical areas in higher education, research and development, national and international business development, sales and marketing, engineering, manufacturing, customer service and organizational growth. As the Founder and President, he leads Ebatco's ISO/IEC 17025:2017 accredited analytical and testing lab services. Before founding Ebatco, Dr. Yang was the Vice President of Commercialization for Hysitron Inc.

# **Abstract: Characterization of Thin Films, Coatings and Small-Volume Materials Using Nanoindentation Based Techniques**

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## Abstract:

Initially invented in the 1980s, nanoindentation based techniques have made significant strides in the past few decades at characterizing materials and devices on nano and micro scales. Sometimes referred to as instrumented or depth-sensing indentation, nanoindentation measures hardness values of specimens beyond the material size and volume limitations of conventional hardness tests. It has become the choice for mechanical characterization of thin films, coatings and small-volume materials.

Nanoindentation relies on precise control of the applied force to an indenter tip and fine measurement of the indenter displacement into a material, or vice versa, precise control of the indenter displacement while measuring force needed to reach that displacement. The generated force-displacement curve during nanoindentation carries distinctive and fingerprint information about mechanical deformation of the tested material specimen. Based on an established and widely-accepted Oliver and Pharr model and method, nanohardness and elastic modulus of the material can be derived from the force-displacement curve. Because of its important role played in the nanotechnology boom and implementation, nanoindentation has been further developed and has evolved considerably over time, expanding well beyond just measuring nanohardness and elastic modulus.

In this presentation, state-of-the-art nanoindentation techniques beyond nanohardness and elastic modulus measurements will be covered. Introduction and reviews on quasi-static nanoindentation for fracture toughness, express property mapping, nanocompression test, stress-strain curve derivation, creep, and stress relaxation will be provided. In addition, exemplary case study results on dynamic nanoindentation of visco-elastic materials will also be discussed.

# Abstract: Unknown Material Identification Through X-Ray Diffraction and Spectroscopies

**Dr. Dehua Yang, FASM**  
**President**  
**Exponential Business and Technologies Company (Ebatco)**  
**Eden Prairie, MN**

## Abstract:

From mislabeled incoming materials to potential contaminants on a part, unknown material identification is a common challenge that faces many engineers and scientists across various industries. Fast, reliable and affirmative identification of the unknown materials is always going to be desired and sought after. Through numerous projects over many years of lab services, a few analytical techniques have been found to be very effective and helpful in identifying unknown materials. These techniques include X-Ray Diffraction (XRD), Energy Dispersive X-Ray Spectroscopy (EDS), Fourier Transform Infrared Spectroscopy (FTIR) and Raman Spectroscopy. Although they may not be readily available in all locations where needs exist, they can be found in central analytical facilities of many companies or industrial service laboratories.

Individually, each technique with its own advantages and disadvantages, can be used to provide a quick solution for a proper, relatively simple and less complex unknown identification project. Together, they are powerful and could solve a great majority of material identification problems. They can determine material types (organic, inorganic, metals, alloys, ceramics, glasses, etc.), elemental compositions, molecular structures, and crystal phases. In addition to identification of unknowns, these techniques can quantitatively determine the amount or concentration of the materials after appropriate calibration. Further, these techniques are non-destructive and only require very small volumes of materials for analysis, making them very attractive for forensic studies.

In this presentation, case studies of all four techniques for unknown identifications will be discussed. Reviews on their individual power and complementary synergies will also be provided.

# **Abstract: Microstructural Characteristics and Failure Mechanism Analysis of Fractured Metallic Materials**

**Dr. Dehua Yang, FASM  
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Exponential Business and Technologies Company (Ebatco)  
Eden Prairie, MN**

## Abstract:

Fracture, as a material failure mode, happens quickly when the stress or load exerted to a part exceeds the maximum stress the material can withstand. Fracture represents a catastrophic and complete failure for a part, or equipment, where functionality is suddenly lost. Thus, fracture resistance capability of a part needs to be tested, studied and understood so as to avoid instances of failure within the part's designed lifetime.

Several kinds of common fracture testing and analysis, such as: tensile fracture, compressive fracture, impact fracture and fatigue fracture, are widely used to aid engineering design and manufacturing quality control. Moreover, these kinds of fracture are also regarded as popular mechanisms of engineering part and system failures. Knowing and understanding these common fracture types, and their characteristics, are crucial for material and engineering professionals.

In this presentation, tensile, compressive, fatigue and impact fractured laboratory specimens, and actual parts, will be examined through microstructural and fractographical observation and analysis. Representative microstructural characteristics and root causes of failures from different types of fracture will be provided and discussed.