

Dynamic, High-Quality and Affordable Training for You and Your Staff

The following tutorials are being offered at the 2007 SAMPE Fall Technical Conference, October 29 - November 1 in Cincinnati, Ohio. To register, go to www.sampe.org and click the Cincinnati link.

Monday, October 29th, 9AM-Noon

Export Control: Basics and Impact on Materials

Maj. Jim Hunter, Air Force Office of Scientific Research

This tutorial will review current export control laws and discuss the impact on advanced materials technology. Today's scientists and engineers face increasing pressures to work across the globe technology base to develop innovative materials and processes. Several large programs have adopted global supply chains, and, have research, development and manufacturing activities in several countries. Questions arise as to:

- What technology information can be shared,
- What is an export,
- What falls under Department of Commerce and what falls under Department of State,
- How does one know the steps to take to determine their responsibility in export control.

A comprehensive review of Export Control in the United States and examples of relevance to the advanced materials community will be discussed. The tutorial will conclude with a question and answer session.

Molecular Modeling Introduction: Tool for Material Scientists and Engineers

Dr. Soumya S. Patnaik, Air Force Research Laboratory

In recent years molecular modeling has become a valuable tool for materials scientists. This tutorial is designed to provide materials and chemical engineers a practical introduction to this computational tool with special emphasis on its scope and limitations. The goal is to provide a broad overview of various molecular modeling methods based on electronic structure theory, molecular mechanics/dynamics and molecular visualization that are used for modeling structure properties of materials. The tutorial is expected to familiarize experimentalists with various modeling techniques and their suitability in addressing specific research problems.

This will be a wonderful opportunity for non-modelers and modelers alike to get a general and tailored overview of this area. The topics to be covered include:

- The basics – “What is molecular modeling?”
- Brief introductions to various methods such as:
 - Quantum chemical methods (ab initio, density functional theory, and semi-empirical),
 - Molecular mechanic (MM),
 - Molecular dynamics (MD),
 - Monte Carlo (MC) techniques
- Illustrative applications of molecular modeling will be shared to demonstrate the power and usefulness of this tool

Introduction to Advanced Composite Materials and Processes

Dr. Charles Browning, University of Dayton

The objective of this tutorial is to school the attendee in the fundamentals of advanced composite materials and processes. This tutorial will cover a wide range of interesting subtopics:

- A comprehensive overview of constituent materials, their basic processes, and recent advances in manufacturing methods will be presented,
- Constituent materials will include carbon fibers, aramid fibers, epoxy resins, polyimide resins
- Associated process discussions will address prepregging and autoclave-vacuum bag curing,
- Recent advances in processing such as liquid resin molding will also be covered,
- Discussions will also address chemical behavior of the materials, including degradation of composite properties.

Carbon Nanotube-Enabled Materials: Potential, Challenges and Applications

Dr. Satish Kumar, Professor, Georgia Institute of Technology

Tubular form of carbon was first recognized in 1991. The field is rapidly growing and more than twenty thousand research papers have been published on carbon nanotubes in this short period. Carbon nanotubes are currently available as single wall, double wall, or as multiwall. This tutorial will briefly discuss their synthesis, purification, and functionalization. Characterization of carbon nanotubes using techniques such as Raman and UV-Vis spectroscopy will be presented. Mechanical, thermal, electrical, and optical properties will be addressed. Solution properties of nanotubes will be discussed in the context of their dispersion in various polymer matrices. Processing, structure, and properties of polymer/carbon nanotube composite films and fibers will be addressed. After nearly 50 years of development in the field of carbon fibers, carbon fiber composites are now finding applications in civilian aircraft structures in significant quantities. In another 50 years, we may expect similar applications for carbon nanotube based composites.

This tutorial will cover the background and history of these exciting materials:

- Development of the various forms(films, carbon fibers (CF), carbon nano fibers (CNF), fullerenes, multi wall carbon nanotubes (MWNT), single wall carbon nanotubes (SWNT), and double wall carbon nanotubes (DWNT)),
- Synthesis and purification processes; characterization of carbon nanotubes (Raman, UV, TEM, fluorescence etc),
- Properties of CNF, MWNT, DWNT, SWNT (mechanical, thermal, electrical, electronic, optical, field emission etc),
- Physical Chemistry and solution properties and chemical functionalization,
- Polymer/carbon nanotube composites (processing, characterization, properties) and applications.

Design and Analysis of Composites

Dr. Steven Donaldson and Dr. Thomas Whitney, University of Dayton

This tutorial will focus on highlighting key factors to consider when designing polymer matrix composite components. Each of the topics will be presented with respect to their implications on design and subsequent analysis. The topics to be discussed include:

- Framework for design (opportunities and challenges offered by composites),
- Overview of composite constituents (fibers, matrices, and reinforcement architectures), tooling, and processing,
- Laminate selection and sizing (including carpet plots, ranking methods, and optimization),
- Bolted and bonded joining of composites,
- Fatigue life prediction, environmental effects, damage tolerance,
- Design allowables and certification,
- Overview of software available for composite design and analysis and demonstration of two software examples,

- Design and analysis examples:
 - composite pipe for burst strength
 - composite wiper arm
 - composite wing for bending and shear response
 - composite canopy arch for bird strike resistance

Monday, October 29th, 1:00 – 5:00 PM

Jet Engines 101: M&P Technology Tutorial and GE Learning Centre Tour

Brant Simmons, GE Aviation

NOTE – this tutorial held at GE Learning Centre

This tutorial will provide the basic information on:

- How a jet engine operates,
- The sections and systems of a jet engine,
- How materials and process engineering plays a key roll in the technology,
- The evolution of the jet engine will also be presented, and,
- The course will include both video and slide portions.

The tutorial will be followed by a guided tour of the GE Learning Centre, which includes engine displays dating from America's 1st jet engine flown in 1942 to the GE90 the world's most powerful aviation jet engine. A brief reception will follow the tour. This tutorial/tour will leave from the Hilton at 1:00 PM and take place at the GE Learning Centre. Bus transportation will be provided, with a return to the Hilton at approximately 5:00 PM. Register Now!

Monday, October 29th, 2:00 – 5:00 PM

Nanotechnology: Health and Safety Overview

Lynn Bowman, University of Dayton Research Institute

Nanotechnology shows tremendous promise in helping our society advance in multiple applications, including information technology, medicine, and pollution prevention. While this exciting area of research brings numerous potential benefits, there are also potential health and safety hazards that some nanoparticles may pose, as the same physical and chemical properties that make nanoparticles unique could also make them more reactive and hazardous in a biological system. As a result, researchers from academia, private industry and government have been working on understanding the health effects of the various classes of engineered nanoparticles and developing practices to safely handle them. This tutorial will provide an overview of the current efforts and key issues associated with toxicology, exposure, regulation, and developing safe work practices.

Morphing Technology: Advancing Systems Performance Beyond State-of-the-Art

Ernie Havens, Cornerstone Research Group, Inc.

Today, morphing materials up through morphing vehicles are being explored by many small and large organizations. This tutorial will provide an introduction to morphing systems design and is an opportunity to obtain an overview and perspective from one of the people who has been working materials through applications. More accurately described as multi-point adaptability, morphing systems are a revolutionary extension of traditional engineering approaches. Morphing technology seeks to exploit new functionality found in emerging materials technologies to achieve efficient reconfigurability.

- Technical discussions will include an overview of many relevant materials technologies and a discussion of their potential to enable adaptive system architectures,

- Detailed designs from one or more recently developed morphing systems will be discussed and analyzed for the first time in a public setting,
- The tutorial will close with discussion on technical team building and management strategies as an impetus for advancing systems performance.

Infusion Processing Technology: Today's Closed Mold Methodology

Dr. Scott Beckwith, BTG Composites Inc.

Infusion processing involves two basic families of technology, resin transfer molding (RTM) and vacuum infusion processing (VIP), with a whole lot of sub-categories that are extremely popular today for closed molding applications. This tutorial examines the similarities and differences of these two basic families. Once that is done, the presentations examine several popular subgroups in particular:

- SCRIMP (Seemann's composite resin infusion molding process), RFI (resin film infusion), RARTM (rubber-assisted RTM), CIRTM (co-injection RTM), and numerous other methods.
- Process variables that influence infusion methods, industry differences (aerospace vs. commercial), tooling, flow "media", preforming approaches, sandwich/core methods, and other important factors regarding these approaches will be covered.
- Resin families that are most often used and their characteristics will also be covered.
- Preform methods widely used for aerospace and commercial structures.
- Examples and discussion of several current and past aerospace and commercial market applications.

Carbon Science and Technology: Carbons, Carbon Fibers, C-C composites, and Nanotubes

Dr. Khalid Lafdi, University of Dayton

This tutorial provides an introductory, up-to-date, yet comprehensive description of the manufacture, properties, analysis, and applications of carbon and graphite materials. The lecture begins by considering the hexagonal graphite lattice from which many forms of carbons/graphites are created. In all carbon structures, the individual graphene layers are comprised of smaller, imperfect segments of this hexagonal lattice that are re-assembled in a wide variety of ways to lead to diverse forms of carbon as the carbon powder, carbon blacks, fibers, nanofibers, nanotubes, C-C composites, and nanocomposites. By understanding these basic concepts, the behavior and processing of all carbon and graphite materials can be more easily understood. The instructor will also dispel many of the "myths" associated with materials such as carbon fibers, carbon nanofibers, and carbon nanotubes.

This tutorial will cover:

- The structure of carbon and carbon forms with basics such as bonding, order, and structure-property relationships,
- Carbon forms such as graphitic and non-graphitic carbons, pitches, cokes, fibers, whiskers and others will be discussed,
- Microscale and nanoscale carbon materials will be reviewed, including PAN and Mesophase Pitch based fibers, whiskers, exfoliated graphite and other nanoelements,
- Carbon-Carbon composites and the various processing methods will be reviewed, and,
- Methods of characterizing carbon structure such as microscopy techniques, diffraction, spectroscopy and surface techniques will be discussed.

Test Methods for Composite Materials

Dr. Donald F. Adams, Wyoming Test Fixtures, Inc.

This tutorial will be presented both as a solid introduction for the novice and as a refresher for the experienced individual working in composite materials. Emphasis will be on establishing guidelines for the selection of a proper test method for each specific application. Although some test methods have been standardized by ASTM, SACMA, ISO and other standards groups, many have not, having evolved as company standards over the years. Thus, it is important to be able to determine which test method to use in a particular situation, and which composite properties can be measured. As will be discussed, testing can be very time consuming and expensive. Thus, it is especially important to do it correctly the first time.

- Tensile, compressive, flexure, shear, and fracture toughness test methods for unidirectional, laminated, fabric, random fiber-reinforced, and sandwich panel composites will be considered.
- Special problems involved when testing at temperatures above and below ambient, and when testing moisture-conditioned specimens, will be discussed.
- In all cases, proper specimen preparation techniques and test procedures will be emphasized.

For more information, contact Priscilla at Priscilla@sampe.org or +1.626.331.0616 ext. 610. To register, go to www.sampe.org and click the Cincinnati link.