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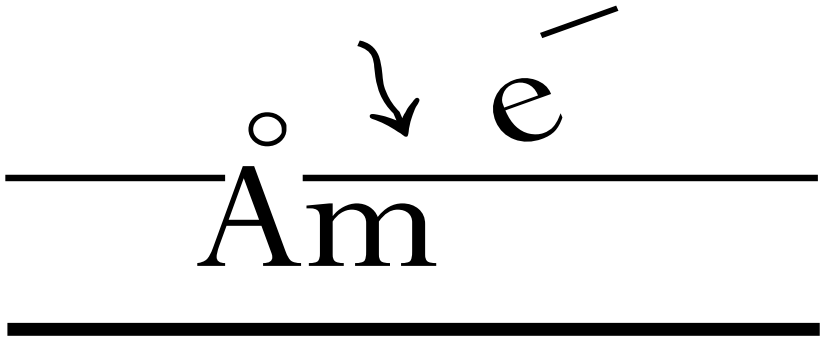
Intelligent, Rapid-Response, Collaborative Solutions to Your Applied Materials Problems



Mission - to improve your productivity

Åme⁻ offers a broad spectrum of materials analytical and testing services to help you shoulder the burdens of process and product development, quality control, and failure analysis. We also provide consultative and expert witness services. We collaborate with you to develop goal-directed solutions to your metal, semiconductor, glass, polymer, inorganic and organic chemical, ceramic, mineral, composite, and contaminant material problems. Among our specialties are adhesive bonding failure analysis, silicone contamination detection and measurement, and corrosion analyses. We can simply perform an assigned analysis. Alternatively, our highly educated and experienced staff of Ph.D. scientists are delighted to discuss the background to your materials characterization task or problem, help you define the analyses necessary to address your problem, produce the needed analyses, and discuss solution pathways elucidated by the results obtained. We may suggest longer-term R&D for greater benefits, if you are interested.

We produce written reports to insure that you can fully understand and independently examine the analytical results and conclusions. This establishes a documented history for future process and product development and control. We can also serve to enhance your corporate memory of problems and their solutions, if you become a regular customer. Please call us to discuss how we can help you create value by addressing your materials issues. Our XPS surface analysis, SEM/EDX, optical microscopy, thermal analysis (TGA. DSC. TMA), FTIR, UV-Vis, GC-MS, wavelength-dispersive XRF, electrochemical evaluations, contact angle measurements, mechanical testing, density and porosity, metallography, fractography, adhesive bond and corrosion failure analysis capabilities give us many powerful tools to apply to your materials and process evaluations. We are your path to replacing speculation with understanding, whether your problem is due to contamination, corrosion, process control, vendor error, counterfeit products, a new operating environment, unknown properties of new materials, a new property requirement, or the many usual unruly suspects.

Characterization, Failure Analysis, Quality Control, & Process & Product Development

Anderson Materials Evaluation

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Surface, Interface, Thin Film, Coating, & Bulk Materials Characterization

Analytical Services

Small-Spot X-ray Photoelectron Spectroscopy (XPS or ESCA) – with Focusing X-ray Monochromator, Differentially Pumped & Rastered Ion Gun Depth Profiling, Provides quantitative elemental and chemical analysis of 10nm depth **&** with ion depth profiling to 2µm in analysis areas of 150 - 600µm dia. Correlation of surface properties with temperature and outgassed species. Unique multiple chemical phase analysis, including hydration. Quantitative analysis of all elements, except H, in all materials with sufficiently low vapor pressure.

FTIR - with a spectral range of 7800 - 350 cm^{-1}, resolution of 0.5 - 16 cm^{-1}, signal-to-noise greater than 42000:1, Specac Golden Gate Mk II Single-Reflection ATR Accessory with Diamond Top-plate and KRS-5 Lense, Pike Technologies VeeMax II Variable Angle Specular Reflectance Accessory - *Ready analysis of many solid and liquid samples as-received using single-reflection ATR with detection depths of 1 - 2 µm and greatly enhanced surface sensitivity using variable angle specular reflectance. Primarily provides identification of polymers and organic materials while complementing the surface chemical analysis of XPS and the thermal analysis of polymers and composite materials.*

Wavelength-Dispersive X-Ray Fluorescence Spectroscopy (XRF) – *Provides highly quantitative elemental analysis to a depth of about 1 micrometer for all elements from C, N, and O and heavier and due to a very low background it provides very low detection limits for all of these elements. This is commonly one of the best analyses to perform for heavy metals and other dangerous elements for which even low concentrations are a concern.*

Scanning Electron Microscopy (SEM) with Digital Imaging and Energy Dispersive X-ray Analysis (EDX) – *Provides 7nm lateral resolution images in secondary electron imaging mode with excellent depth of field and measures the size of small features with image analysis. We do specimen cross sectioning and polish and etch of metals for metallographic inspection. We can also provide Robinson backscatter images, which distinguish light elements from heavy elements. EDX provides semi-quantitative analysis of elements for carbon and all heavier elements to depths of 1 to 2 µm with lateral dimensions of about 0.5 µm. We can provide elemental concentration maps or line scans for up to eight elements.*

Metallographic Optical Microscopy – Used with relatively flat specimens, or with specimen polishing and cross-sectioning techniques – *Provides 37.5 - 400X optical images in bright field, dark field, polarizing, and Nomarski differential interference contrast observation modes.*

Inspection Microscopy - Offers greater depth of field Virtually all materials are examined prior to other analyses for insight into heterogeneities of chemical or physical phases and microstructure. Documents the appearance of samples further analyzed by other means so future problems can better be identified as similar or different based on microscopic appearance.

Thermal Analysis (Differential Scanning Calorimetry (DSC), Thermogravimetry (TG or TGA), Thermal Mechanical Analyzer (TMA) – DSC and TMA can be cryogenically cooled. – TG provides weight loss due to decomposition, outgassing, combustion; or weight gain due to absorption or reaction with environment, and can yield quantitative composition and hydration information. DSC provides measurement of exothermic and endothermic reactions, melting and precipitation energies, degree of polymer cure, glass transition temperatures, and chemical reaction temperatures and quantization. TMA measures thermal expansion, glass transition or softening temperatures, crystalline to amorphous phase transitions, other phase transitions, and rheology. Operation in a glove box allows the handling of materials susceptible to water or air absorption or oxidation. Measurements can be made under a variety of gaseous atmospheres (TG, DSC) or under vacuum (TG).

Gas Chromatography - Mass Spectroscopy (GC- MS) – with SPME for extraction of volatiles. *Provides for the separation and identification of many organic compounds in complex mixtures, such as found in some plastics, adhesives, sealants, lubricants, cosmetics, pharmaceuticals, food products, fumigants, and insecticides.*

Electrochemical Characterization – Potentiostatic, galvanostatic, potentiodynamic polarization, and electrochemical impedance spectroscopy (EIS) techniques - *Evaluates materials compatibility, environmental corrosivity, potential methods for protection against corrosion, and coating breakdown. Allows the characterization of corrosion phenomena such as corrosion rate, localized attack (pitting, crevice corrosion), galvanic attack, and interfacial hydration.*

Quadrupole Mass Spectrometer Residual Gas Analyzers in XPS/ESCA with Heating, as Portable Atmosphere Sniffer, on TGA/DSC Outflow Gas – *Provides gas & vaporizable species identification 1 - 200 amu.*

Contact Angle Measurements - Measurement of liquid - solid interface properties – *The use of several liquids on a surface allows the surface tension and surface free energy to be determined. The polar and dispersive parts of the free energy can be measured.*

UV-Vis Spectrophotometry with Reflectometry Addition

Density/Porosity Measurements

Mechanical Testing - Tensile testing with load cells from 10,000 to 4.4 pounds, compression testing, bend testing, lapshear testing, peel testing, high temperature testing, head speed, load rate, and strain rate controls, Shore A and Shore D hardness testing, static coefficient of friction

Coating and Film Thickness Measurements – using XPS on extremely thin films and coatings, SEM/EDX imaging, and cross-sectioning or radial sectioning on thicker coatings.

Anderson Materials Evaluation, Inc.

Surface, Interface, Thin Film, Coating, & Bulk Materials Characterization

Applications of Surface Analysis, Thermal Analysis, FTIR, SEM/EDX, Optical Microscopy, RGA Mass Spectroscopy, & Electrochemical Analysis

Adhesion

- Determine location & cause of adhesive bond failure
- Identify cause of coating or thin film peeling/delamination
- Provide airborne contaminant collection kits to allow measurement of silicones and fluorocarbons that inhibit adhesive bonding
- Provide tape transfer contaminant collection kits to measure the silicone and fluorocarbon on surfaces
- Determine the composition of an adhesive/sealant
- Measure adhesive and primer degree of cure
- Evaluate surface preparation cleaning or anodization processes
- Determine thickness of silane bonding agent film
- Check polymer surfaces for plasticizer, excessive fire retardant, fingerprints, hand lotion, tape residues, or mold release agents capable of degrading bonding
- Identify hydrated or laminated layer species on the surfaces of inorganic filler particles
- Determine whether surfaces are too alkaline (basic) for proper bonding

Chemical Identity

- Quantitative composition elemental analysis on surfaces or to depths of about 1 micrometer
- Quantitative multiple chemical phase identifications on surfaces
- Measurement of low concentrations of heavy metals or other dangerous elements
- Separation and measurement of organic compounds in complex mixtures
- Identify outgassing species & rates
- Use of thermal decomposition to identify and measure combinations of polymers and chemicals
- Use of latent heat of melting and melt temperatures to check purity and identify contaminants
- Microanalysis of qualitative elemental compositions
- Multilayer coating structure identification
- Composite & ceramic materials fracture surface compositions
- Identify leached or adsorbed species
- Heated/etched/leached surface composition changes
- Stoichiometry of sputter-deposited, chemical vapor deposited, or reaction-formed films
- Distinguish 3 and 4 Å absorbents

Chemical Reactivity & Stability

- Determine surface chemistry of particles
- Measure surface or bulk water content
- Determine weight & identity of thermal decomposition species
- Find chemical cause of film stresses
- Find nickel sulfide cause of tempered glass shattering
- Measure surface and bulk chemical changes upon exposure to reactive environments or chemicals, UV, heat, light, or plasma (RF or microwave)

Composite Materials

- Composition at fracture surface
- Composition at interfaces between components
- Particle or fiber surface properties affecting strength, resin wetting, pull-out, or degradation
- Development and control of surface preparation processes for adhesive bonding or degradation control
- Control and preparation of particle or fiber properties for improved adhesive bonding
- Evaluation of surface treatments to improve wear or hardness properties
- Examine component and finished product surfaces for mold-release agents or contaminants
- Measure tensile & compressive strength, bending

Contamination & Cleaning

- Identify and measure surface contamination
- Provide facility contamination collection kits (ambient and high temperature airborne, facility surfaces) for XPS analysis of collected contaminants
- Test efficiency of aqueous, solvent, or CO_2 SnowJet cleaning processes
- Determine suitability of plasma (RF or microwave), UV , & ultrasonic cleaning processes
- Identify residues from solvents and qualify solvents
- Measure surface-segregated impurities & phases due to bulk-lattice instability, heating, or surface reaction-induced diffusion
- Qualify surfaces of high value-added components for further non-reversible processing
- Identify and measure surface or interfacial contaminants, oxide type, corrosion products
- Identify residues from aggressive glass cleaning due to the leaching of some glass components

Corrosion & Degradation

- Corrosion product identification
- Improve protective coatings & surface treatments
- Determine chemical degradations due to radiation, (UV, x-ray, microwave), plasma, or kinetic particle
- Accelerated testing for corrosion susceptibility
- Identification of corrosive agent or mode of corrosion, even prior to visible corrosion
- Measure water penetration depth in polymer and other coatings - detect presence at interfaces
- Determine compatibility of materials
- Measure corrosion rates
- Determine susceptibility to pitting or crevice corrosion

Electronics

- Determine cause of soldering, bond pad, and adhesive bond difficulties
- Find cause of electrical breakdown
- Evaluate PCB laminate interfaces & surface conformal coatings
- Identify photoresist or wax residues
- Depth profile TiN, WN_2, or other barrier films on Si or SiO_2 to determine barrier properties
- Measure surface segregated impurities from electroplated metals such as gold and copper
- Depth profile multi-film contact structures
- Evaluate cure of adhesives, potting compounds, thermal transfer agents, and sealants
- Measure outgassed species from component materials and contaminants & outgassing rates for applications in hermetically-sealed packages
- Characterize new low dielectric materials
- Evaluate the cleanliness of ceramic and plastic packaging materials and of gloves and tools
- Find cause of leakage currents in electrical connectors or between bond pads
- Determine polysilicon grain sizes
- Measure the thickness and precise stoichiometry of oxides, nitrides, and other film layers
- Develop new processes for implementation of new low dielectric materials

Metallurgical

- Measure thickness and chemistry of surface oxide or other reaction product films
- Identify metal allloys
- Identify cause of metallic intergranular failures
- Improve friction & wear properties
- Measure/distinguish surface & near-surface graphitic & carbidic inclusions affecting surface appearance, wear, hardness, corrosion properties
- Metal-matrix composite analysis for alloy or reaction product composition at interfaces
- Improve surface hardening, anti-abrasion coatings
- Characterize specialized surface coatings such as forsterite insulating coatings for transformer steel
- Examine surface composition of heat-affected zones near welds or brazed joints
- Determine composition of corrosion sensitive material and probable process or exposure cause of sensitization
- Examine surface properties of metal powders for sintered powder metallurgical products
- Mechanical Testing in tension, compression, bending

Polymer

- Identification in bulk, near surface, & surface
- Determine degree of cure
- Fiber-reinforced or filled polymer composite characterizations, including fiber & particle interface properties
- Mechanical testing (tensile, compression, bending)
- Determine surface composition of copolymers
- Identify and measure surface-segregated plasticizer component
- Determine outgassed species and rates
- Characterize surface degradation layers due to oxidation, hydration, or radiation exposure
- Examine surface/bulk concentrations of catalysts, cross-link agents, colorants, & plasticizers
- Measure the glass transition temperature
- Measure thermal expansion properties, CTE
- Separate and identify organic components with GC-MS
- Measure reaction exotherms and endotherms in inert or reactive atmospheres
- Surface treatment characterization for improved wetting and adhesion for printing & painting
- Characterization of primers and adhesion promoter layers for chemistry, composition (mixture or interphases at interfaces), & thickness
- Weight-loss on heating, inorganic filler weight
- Shore A and Shore D hardness measurements

Industries Supported

Adhesives, Aerospace, Automation Equipment, Automotive, Batteries, Biomedical Devices, Building Materials, Ceramics, Chemical, Coatings, Cosmetics, Communications, Composites, Construction, Defense, Electronics, Energy, Fasteners, Glass, Machine Tool, Materials Handling, Materials Processing, Marine, Metal, Mining, Optical Devices, Paint, Paper, Pharmaceutical, Pipeline, Plastics, Power, Surface Treatment, Semiconductor, Automation Equipment, Textiles, Thin Film, Transportation, & Welding and Joining Industries