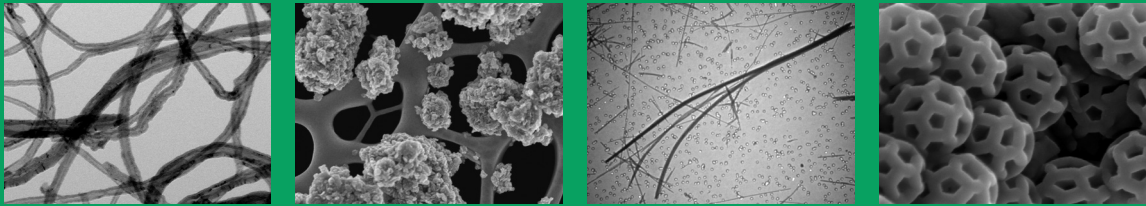
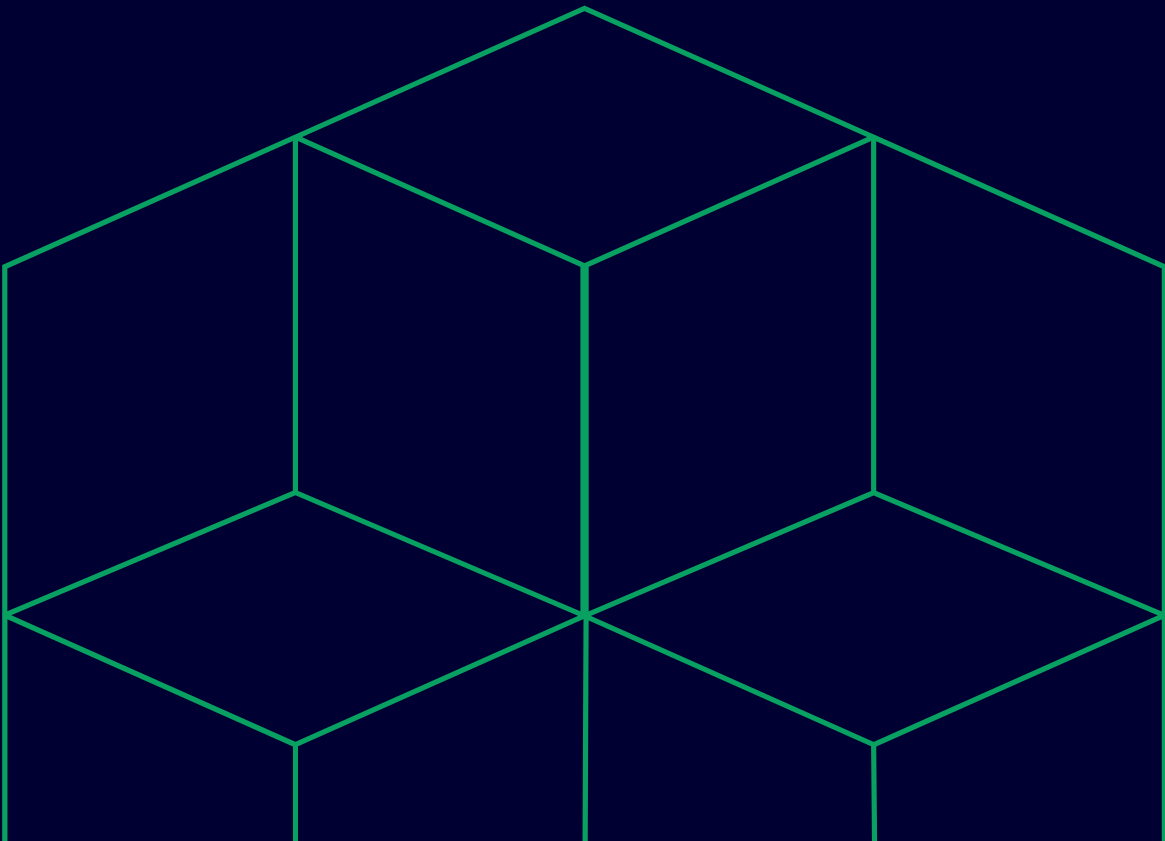


RJ Lee Group

2024 Laboratory Testing Guide



Materials Analysis and Investigation Laboratory Services



An Overview

Materials Analysis

Our analytical laboratory is supported by a team of subject matter experts whose experience spans the world of materials including steel, ceramics, polymers, natural materials, composites, organics. Our facilities are equipped to evaluate material chemical composition, compositional distribution, and properties from the macro- to the micro- to the nanoscale. We evaluate component parts (large and small), thin films, welds, coatings, catalysts, fibers, pharmaceuticals, medical devices, construction equipment, concrete, and more. Field-deployable capabilities to perform analysis in situ are available, as well as contaminant, dimension, and composition analysis for additive manufacturing.

Product Development and Commercialization

We help our clients transform their innovations into new products that can be manufactured reliably with the expected performance. We support their efforts in quality control measures and provide scientific insight to inform corrective actions. We perform accelerated life performance and remaining life assessment testing in simulated operational environments. We strive to work as partners with our clients in the development process or as a third party to demonstrate materials performance.

Particulate Characterization

Whether foreign particulate assessments in pharmaceutical manufacturing, evaluation of nuisance dust claims or environmental health and safety issues, our experienced staff coupled with our suite of state-of-the-art electron microscopes are ideally suited to address even the most complex particulate issues.

Our subject matter experts routinely assist our clients in recommending sampling procedures and protocols, determining particulate composition and ultimately the source of the particulate. We provide our clients with a scientific foundation to respond to regulatory concerns, institute appropriate health and safety measures, and establish mitigation procedures. Our experts are at the forefront of technical efforts surrounding nano-particulate and are available to respond to inquiries regarding laboratory analysis of any type or field sampling strategies.

Capabilities and Features

Optical Microscopy

Features:

- Stereo Optical Microscopy
- Polarized Light Microscopy
- Digital Microscopy (portable)
- 3-D Surface rendering
- Transmitted and reflected light capabilities
- Image mapping/montaging

Scanning Electron Microscopy with Energy Dispersive X-ray Spectroscopy (SEM/EDS)

Features:

- One of the largest selections of SEMs available worldwide
- Wide range of variable diagnostic capabilities
- Variable pressure and large-size chambers
- Tungsten and Field Emission SEMs (FESEM)
- Secondary electron and backscattered electron imaging
- Light element EDS detection
- X-ray element mapping
- Custom mapping correlation

Ultra-High-Resolution In-Lens SEM/STEM

Features:

- 60x - 2,000,000x
- 0.2kV to 30kV Accelerating Voltage
- Secondary electron and backscattered electron imaging
- Dark field and bright field STEM imaging
- 30mm² SDD EDS detector
- Particle sizing available upon request

Automated Computer Controlled SEM (CCSEM)

Capabilities:

- Inclusion Analysis / Steel Cleanliness Analysis
- Particle Size Distribution (PSD) Analysis
- Particle Size Distribution with Elemental Composition (PSD/EDS) Analysis
- High Atomic Number (High-Z) Feature/Particle Analysis

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Capabilities and Features

High Resolution Scanning Transmission Electron Microscopy (STEM)

Features:

- 100x - 10,000,000x
- 120kV or 200kV Accelerating Voltage
- Secondary electron, dark field, and bright field imaging
- Electron diffraction
- Field emission source
- EDS detector
- Particle sizing available upon request

Transmission Electron Microscopy (TEM)

Features:

- 120kV or 200kV Accelerating Voltage
- Electron diffraction
- EDS detector

X-ray Photoelectron Spectroscopy (XPS)

Capabilities:

- Survey Spectra (qualitative and quantitative information)
- Depth Profiling Analysis
- High Resolution Spectra (Chemical state analysis)
- Line Scans
- Area Mapping

Raman Spectroscopy

Features:

- High spatial and spectral resolutions (800mm spectrometer)
- 3 laser sources: 473nm (blue), 633nm (red), 785nm (near IR)
- Wide mapping capabilities from 2 microns to 100mm x 80mm
- High precision, ultra-fast confocal imaging

Capabilities and Features

Metallurgical Services

Capabilities:

- Full-Service Metallography Lab: Etching, Sample Cross Sectioning, Drilling, Cutting, Mounting, Grinding, Polishing, Grain Size Analysis
- Heat Treatment
- Hardness/Microhardness Testing
- Corrosion Assessment and Testing
- Metallurgical Modeling
- Field Deployable Services:
 - Digital Microscopy (portable)
 - Surface Replicas
 - Handheld XRF for Chemical Analysis
 - Field Metallography and Microstructural Evaluation

Non-Destructive Evaluations

- Dye Penetrant Testing
- Magnetic Particle Inspection
- Impact Echo
- Radiography
- Fourier Transform Infrared (FTIR) Spectroscopy
- Attenuated Total Reflectance (Ge crystal)
- Grazing Angle
- Reflectance
- Raman Analysis
- Gas Chromatography with Mass Spectrometric Detection (GC/MS)
- Elemental Analysis (AA, ICP/AES, ICP/MS, OES, Leco)
- Surface Area /BET Analysis (Gas adsorption - desorption)
- Particle Sizing by Laser Light Scattering
- Environmental Chamber Testing

TGA / DSC

- Thermogravimetric Analysis (TGA)
- Differential Scanning Calorimetry (DSC)
- Simultaneous DSC/TGA

Sample Preparation Services

- Ultra-microtomy
- Electropolishing, Tripod Polishing, & Electrojet Polishing
- Carbon & Metal Coating
- Extraction Replicas
- Dimple Grinding

Unique sample preparations developed per client or sample requirements

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Capabilities and Features

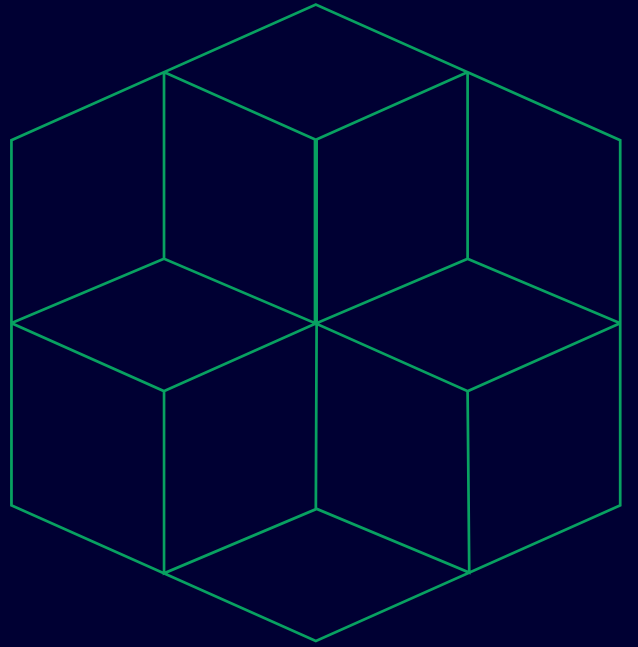
Additional Testing and Services Available

- Wavelength Dispersive X-ray Spectroscopy
- Mechanical Testing
- Focused Ion Beam Sample Preparation
- HR-TEM
- Ion Milling
- Additive Manufacturing Quality Control Testing

Powder Metals

In Powder Metals (PM) applications such as 3D printing, the flow and packing behavior of PM is influenced by particle size and shape distributions. These properties can be measured in statistically meaningful ways using computer controlled scanning electron microscopy (CCSEM). Compositional information can also be performed with the particle-by-particle analysis using EDS. This will allow investigation of changes in powder metal composition, or the presence of extraneous particulate. The experts at RJ Lee Group can work with your team to answer questions and find solutions for your powder metal manufacturing facility.

Analysis	Technique
Contaminant Identification of Ceramics, Non-Metallics, and Metallic Aluminum	Heavy Liquid Separation
Particle Size Distribution and Shape Analysis	CCSEM with Optional EDS
Powder Cross-Contamination Detection	CCSEM/EDS
Manual SEM/EDS Analysis	SEM/EDS



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