

Specifications

The Naval Research Laboratory requires an energy dispersive X-ray fluorescence (EDXRF) measurement system to provide chemical and thickness characterization of bulk materials and thin films.

1. General

A benchtop spectrometer designed for versatile, high-speed quantitative and qualitative analysis of elements from sodium (Na) through uranium (U), to parts per million (ppm) levels in solid, powder and liquid substances.

2. Detector

- a) The detector must be able to operate in air, vacuum or helium environments.
- b) Energy resolution must be lower than 150 eV.
- c) The minimum sensitivity for certain elements must be as follows:
 - Chromium (Cr) < 20 ppm
 - Copper (Cu) < 25 ppm
 - Zinc (Zn) < 5 ppm
- d) The beryllium window's thickness must not exceed 8 micron in order to have good light-element sensitivity.
- e) The primary excitation must be filtered for optimal control of peak-to-background with at least 7 transmission filters plus direct excitation for full coverage Na through U without requiring any alignments or adjustments. Filters must be able to be customized for specific applications.
- f) The liquid nitrogen dewar for cooling the detector, must be big enough to last at least 5 days before refill is needed. The dewar must not be bigger than 6 liters.

3. X-ray tube and high voltage power supply

A Rhodium target x-ray tube must be operated with programmable settings of distances between sample and x-ray tube to achieve maximum intensity. The Rhodium (Rh) Target X-ray tube must be rated as follows:

- a) Voltage range 4 - 50 kV adjustable in 1 kV steps.
- b) Current range 0.02 – 1.98 mA adjustable in 0.02 mA steps.
- c) There must be radiation shielding and triple-redundant interlock safety system.

Cooling of the system must require no external accessories or connections. X-ray tube must be tested to achieve < 0.3% relative standard deviation (rsd) stability over 8 hours of continuous operation.

4. Optics

The X-ray spot size on the sample must be 9mm in diameter with optional beam collimators available to vary the spot size on the sample to 12mm, 8.8mm, 5.6mm, 4.5mm, 3.0mm and 1.5mm in diameter.

5. Sample handling

- a) The chamber must be fully configurable for air, vacuum or helium options.
- b) Sample chamber must have the capability of being under a vacuum of 3×10^{-3} Torr or lower.
- c) The included vacuum pump must be a computer-controlled dry vacuum pump. Computer-controlled valve assembly for pumping and venting, hoses, fittings and power cables must be included.
- d) The chamber must be able to accommodate a 20-position or more sample stage for 20 or more standard 32-mm diameter samples.
- e) There must be an option to accommodate a stage for multi-point automated analysis of any wafer up to 200 mm so an elemental γ -theta mapping analysis can be performed. Adapters for wafer sizes of 150mm,
 - a) 100mm and 75mm in diameter must be provided.
- f) Sample chamber must be able to accommodate a 10-position or more auto-sampler stage to accommodate 10 or more samples from 32-mm to 47-mm in diameter with an option to spin these samples, for materials that may not be completely uniform or homogeneous.
- g) Helium purging must be available for a liquid sample analysis.

6. XRF software

The XRF application package must be able to perform analysis of layered structures. The following items must be included:

- a) The application must be backwards compatible spectra files generated by a KEVEX 771 XRF system.
- b) Analysis using both a standard-less and standard-base methods. For example, it must be able to perform analysis of standard-less samples by reference to chemical elements with standard values.
- c) Measures thickness, mass and composition of up to 6 layers containing any number of elements and correct for thickness and matrix effects, including inter and intra-layer absorption, secondary fluorescence, and substrate fluorescence.
- d) During data collection the application must have the option to use as many filters as needed on each sample for complete multi-element analysis with optimal sensitivity.
- e) The application must run on Microsoft Windows XP Pro SP2 and Windows Vista.
- f) Original CD's of the all the software including operating system and applications must be supplied.
- g) Analysis software must be able to be installed in at least two additional computers for offline analysis.

7. Computer

A standard desktop computer system must be included with the following features:

- a) Processor Intel Q6700 @ 2.66 GHz or better.
- b) 4 GB Memory and 500 GB SATA hard drive or larger.
- c) 24 inch LCD monitor or larger, keyboard in standard U.S. English layout.
- d) Internal 16x DVD±RW drive or better.
- e) At least 2 ethernet ports for simultaneous communication with spectrometer and local network.
- f) Microsoft Windows XP Pro SP2 or Windows Vista Ultimate Operating System in English.

8. Documentation

- a) Complete user and technical documentation on CD-ROM.
- b) Technical manual in paper and electronic (pdf) format.
- c) User guide and software manual in electronic (pdf) format.

9. Installation

The equipment will be delivered and installed at the Naval Research Laboratory, Washington, DC at a location designated by the contracting officer's representative. On-site spectrometer installation, performance testing and user orientation must include:

- a) Two (2) days on-site with local service engineer.
- b) Hardware overview, system testing and preventive maintenance topics.
- c) Software overview and development of basic quantitative methods.

10. Options

- a) Y-theta stage for multi-point, multi-position analysis of any size wafer up to 200mm in diameter. Adapters for wafer sizes of 150mm, 100mm and
a) 75mm in diameter must be included.
- b) CCD Camera for XRF Sample Imaging to facilitates identification, positioning and analysis of small samples or features. This must be an all digital design, with USB connectivity and a dedicated light source.
- c) Additional laptop PC for offline analysis.
- d) Thickness standards that include Al, Co, Cr, Fe, Mo, Pt, Ru, Ta, Ti and W on both Ni and Si holders.