Statement of Work for

Scanning Transmission Electron Microscope Electron Beam-Induced Current System

Title: STEM Electron Beam Induced current (EBIC) System, double tilt holder

Document Date: 03 June 2026

1. Scope: A EBIC detector requires installation in the AFIT Cleanroom lab. The EBIC system must be able to provide data sufficient for a Master's level thesis or doctorate level dissertation on time scales that can accommodate 10-week AFIT courses and 18/36 month MS/PhD programs. The expendable material requirements in the form of chemicals, gases, power, etc. must be compatible with AFIT's current Clean Room facility (standard 120 V AC Wall power, no concrete floor pad). Use of the tool must be possible with Windows operating systems without network access.

1.1 Background: Materials characterization and analysis is the driving force for advancing technological capabilities and occurs from the macroscopic to the atomistic scale. While AFIT microelectronics and physics education has benefited greatly from the use of Scanning Electron Microscopy (SEM) characterization, SEM is limited to surface level analysis. Internal structural, chemical, and energetic analysis requires advanced microscopy and spectroscopy techniques, which requires a different suite of detectors. Fortunately, our existing Zeiss Crossbeam SEM can accommodate such a detector suite produced by manufacturers such as Nanoelectronic Imaging (NEI). The EBIC system will thus enable the study of ultra-high temperature materials, microelectronics, microelectromechanical systems (MEMS), and materials for aerospace applications. The new EBIC capability at AFIT will enable materials research from many different research groups both internal and external to AFIT/WPAFB/DoD, providing a unique ability to link cross-correlative, multi-imaging and analysis modalities from the macroscopic to the atomic levels. The ability to 'link' cross-correlative, imaging/analysis modalities across length scales on the same instrument system allows students and research groups for a more detailed and comprehensive materials analysis and increases experimental throughput. This instrument supports EENG 675, EENG 717, and EENG 777.

2. Period of Performance: Delivery, installation, and on-site calibration no more than 8 months after contract is awarded.

3. Training Requirements: The contractor shall train all AFIT microelectronics faculty and cleanroom staff at the time of installation such that current AFIT measurement campaigns can be completed and future students/staff can be trained by the AFIT personnel. Additional training may be requested by the AFIT member(s) while the contractor is on-site for calibration/adjustments/repairs through the life of the warranty.

3. Delivery Location: [redacted], WPAFB, OH 45433-7765, [redacted]

4. Requirements/Salient Characteristics: The contractor shall train all AFIT microelectronics faculty and cleanroom staff at the time of installation such that current AFIT measurement campaigns can be completed and future students/staff can be trained by the AFIT personnel. The instrument shall be compatible with instruments already installed on the Zeiss Crossbeam SEM, such as the Oxford Instruments ESD/EBSD.

A) System Compatibility:

- Item 1.1: The EBIC system must be fully compatible with the existing Zeiss Crossbeam 350 SEM, including integration with the chamber, use of an available accessory port, and compatibility with the SEM's scan generator.
- Item 1.2: All necessary hardware for installation, including a vacuum feedthrough flange, in-chamber cabling, and external connectors, must be included.

B) Performance Specifications:

- Item 2.1 (Current Measurement): The system must include a preamplifier capable of measuring currents with a sensitivity of 10 picoamperes (pA) and additional amplifier capable of less than 5 picoamperes (pA) or better.
- Item 2.2 (Gain & Bandwidth): The EBIC amplifier must have an adjustable gain range from at least 10^3 to 10^9 V/A or better and an adjustable bandwidth of at least 1 kHz to balance signal-to-noise and acquisition speed and suitable for large semiconductor EBIC signals.
- Item 2.3 (Resolution): When integrated with the Zeiss Crossbeam 350, the system must be capable of producing EBIC maps with a spatial resolution of 50 nanometers (nm) or better on a known test sample.
- Item 2.4 (Probing): The system must include a micro-manipulator or nanoprobing solution capable of making electrical contact with features 1 micron in size or smaller, inside the SEM chamber.
- Item 2.5 (Consumables): FIB Liftout STEM EBIC chips, DT-style, 2-lead/10 μm gap (Pack of 10)

C) Software & IT:

- Item 3.1: The control software must be compatible with Windows 10 (or specify the required OS). All necessary software licenses for operation must be perpetual.
- Item 3.2: The system must be capable of synchronizing with the SEM's scan generator to simultaneously acquire a secondary electron (SE) image and an EBIC current map at resolutions up to 2048x1536 pixels.

- Item 3.3: The system must be able to operate without an external network connection.

5. Warrant Requirements: Minimum 1 year warranty on system, materials, and labor. Throughout the life of the warranty, the contractor will conduct on-site calibration of the system if needed or virtually assist in the calibration of the system completed by a trained AFIT member. If on-site calibration is required, the contractor will be available to provide hands-on training to the AFIT member while calibrating/adjusting the EBIC System.

6. Payments: 100% payment upon completion of all requirements specified in this document through Wide Area Workflow (WAWF) (https://wawf.eb.mil)