Job Description

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| **Job Title:** | Electron Beam Lithography Senior Scientist |
| **Department:** | Institute for Quantum Computing |
| **Reports To**: | Nanofabrication Process Engineering Manager |
| **Jobs Reporting:** | None |
| **Salary Grade:** | USG 11 |
| **Effective Date:** | July 1, 2017 |

**Primary Purpose**

The Electron Beam Lithography Senior Scientist is a professional level staff person, primarily responsible for process support for Electron Beam Lithography (EBL) and other associated tools in the Quantum NanoFab. This position is responsible for consulting with EBL users to troubleshoot or improve their lithography results, as well as instructing new users in the operation of EBL tools. This position is also responsible for the development, documentation and maintenance of new and existing EBL processes. This ultimate purpose for this position is to enable the Quantum NanoFab to leverage its suite of Electron Beam Lithography equipment to enable cutting edge research in the fields of nanotechnology and quantum computing. This position is to be a key member of the Quantum NanoFab team. The Quantum NanoFab's mission is to maintain a professional, efficiently run, state of the art operating environment which is used by researchers of many different backgrounds. A chief goal is the maintenance of high quality and consistent operations, comparable to those found in high-end high-tech integrated circuit manufacturing environments. The Electron Beam Lithography Senior Scientist is to play a key role in achieving this fundamental goal.

**Key Accountabilities**

**Equipment maintenance**

**The incumbent has the following responsibilities with regards to maintenance of UV and E-beam lithography equipment:**

- Manage the Statistical Process Control (SPC) initiative, monitoring equipment performance across lithography modules.
- Identify and generate new standard processes as needed to monitor equipment performance.
- Manage process of remedial action/repairs when significant degradation in equipment performance is uncovered by SPC analysis.
- Consult with local equipment technicians and remote vendor engineers to assist them during repair and preventative maintenance work.
- Manage process testing tasks after repair or preventative maintenance work to verify acceptable equipment performance.
- Perform "quick response" repair/troubleshooting service if lab members experience minor issues with equipment operation.
- Establish, maintain and enforce policies for equipment operation and handling of materials.

**Lab member guidance, consultation, training and service**

**The incumbent has the following responsibilities with regards to user consultation, training, and service:**

- Provide new lab member orientation lectures (shared responsibility).

- Establish, maintain and conduct an Electron Beam Lithography introductory seminar (shared responsibility). The purpose of this seminar is to provide theoretical and practical, hands-on instruction to new EBL users.
- Establish, maintain and conduct a UV lithography introductory seminar. The purpose of this seminar is to provide theoretical background and hands-on experience performing UV lithography processes.
- Manage process of training new lab members in operation of highly advanced Electron and UV lithography equipment.
- Manage documentation repository for E-beam and UV lithography toolset.
- Generate documentation as needed to aid labmembers in operation of E-beam and UV lithography equipment.
- Instruct new lab members in cleanroom health and safety protocols.
- Enforce all health and safety guidelines in accordance with UW and facility protocols.
- Meet with new lab members to determine their fabrication needs. Provide relevant information regarding equipment capabilities and established baseline processes so that new lab members can be brought on board quickly.
- Review newly proposed lab member processes to determine feasibility in the Quantum Nanofab facility and ensure that there are no cross-contamination or other negative tool impact risks present. Incumbent may be called upon to intervene and prevent lab members from performing work which may damage or contaminate lab equipment. Incumbent will have the support of the process engineering and management staff for this task.
- Provide hands-on training/qualification for lab members on all pieces of UV and E-beam lithography equipment.
- Provide demonstrations as needed to educate lab members and ensure optimal equipment use.
- Document standard operating procedures for UV and E-beam lithography equipment. Incumbent is also responsible for the revision and maintenance of these SOP documents.
- Serve as a “resident expert” in the areas of UV and E-beam lithography. This entails self-directed learning and practice in order to master the advanced features of the facility’s UV and E-beam lithography equipment. Documenting and disseminating the results of these learnings are imperative in enabling the Quantum NanoFab community to make excellent use of this equipment.
- Develop EBL processes and perform hands-on work for lab members and remote users who may require Electron Beam Lithography or UV lithography services.
- Develop “process kits” and other resources to facilitate the preparation of samples and data for Electron Beam and UV lithography systems.
- On occasion perform hands-on work for lab members and remote users who may require etch, film deposition or characterization services.

**Process development and troubleshooting**

**The incumbent has the following responsibilities with regards to process development and troubleshooting:**

- Manage process for identifying and creating new UV and E-beam lithography processes for the benefit of the Quantum NanoFab community.
- Manage process for revising and maintaining existing UV and E-beam process recipes.
- Keep up to date with advancements and changes in UV/E-beam lithography processes and bring this information into the Quantum NanoFab community through the generation and documentation of new process recipes and technical reports.
- Interact with equipment vendors in order to implement or develop new advanced processes.
- Serve as a primary contact to consult with lab members regarding their failed or non-optimal processes in the areas of UV and E-beam lithography. Incumbent should have a command of the relevant metrology techniques (scanning electron microscopy, optical microscopy, ellipsometry) and

lithography physics/chemistry in order to identify reasons for process failure. Incumbent should then be able to suggest appropriate solution(s).

**Required Qualifications**

**Education**

- PhD degree or Master's degree and equivalent experience

**Experience**

- Minimum 3-4 years' experience developing and running integrated circuit (IC) fabrication processes in well-established, world-class device fabrication environments in industry or academia.
- Proven ability, solid hands-on and theoretical semiconductor experience and excellent knowledge and understanding of the operation of state-of-the-art fabrication equipment.
- Extensive practical experience in designing and running IC fabrication processes. It is expected that the incumbent will be intimately familiar with the operation and development of recipes run on UV and advanced, purpose-built E-beam lithography equipment.
- Significant experience using a turn-key E-beam lithography tool such as Raith (150/Voyager/E-line), Raith/Vistec (EBPG), JEOL (JBX), Elionix (ELS).
- Significant experience using scanning electron microscopes (SEM) and optical microscopes is also essential.
- Experience in designing photomasks and operating a UV mask aligner is also highly valued. Experience with other integrated circuit manufacturing equipment such as high temperature furnaces and RTAs, PVD and CVD systems, RIE tools, wet chemistry workstations are assets.
- The incumbent will be working primarily with the Quantum NanoFab's JEOL JBX-6300FS EBL system, Raith150-TWO EBL system, SUSS MA-6 mask aligner, and Heidelberg MLA150 UV lithography system so previous experience with these specific tool models is highly desirable.
- Previous experience with GenIsys BEAMER software is also an asset.
- Software skill requirements are summarized below:

**Knowledge/Skills/Abilities**

- Knowledge of industry standard GDS-II design software such as L-Edit or other equivalents is essential.
- Knowledge of Python language is also an asset for automating tasks in BEAMER and JBX software packages.
- Service oriented. Exceptionally positive, diplomatic and constructive attitude as required to effectively work with a large number of people with a broad range of experience, educational and cultural backgrounds both within and outside the university

**Nature and Scope**

**Contacts:**. Internal contacts include Fab team members, UWaterloo staff, faculty members, graduate students, Co-op students and Post Docs. External contacts include professionals, suppliers, customers and visitors. The incumbent routinely obtains, clarifies and discusses information and problems with both internal and external contacts.

**Level of Responsibility:** The position is responsible for helping to maintain the performance of highly valuable equipment in the Quantum NanoFab by regular proactive testing and by quickly responding to problems that have been noted by our lab members. This position is ultimately responsible for maximizing the value that lab members receive when using our highly advanced E-beam lithography equipment. The position entails initial supervision of lab users (graduate students, post-docs) until they have reached a sufficient level of proficiency. The job has defined highly-specialized work with minimal supervision and provides guidance to many others in the lab.

**Decision-Making Authority:** The incumbent is expected to work independently in carrying out all tasks under their scope. In complex or unusual situations the incumbent is expected to seek assistance both within and outside the Quantum NanoFab team as required.

**Physical and Sensory Demands**: Extensive time may be spent sitting in front of the consoles for the Raith or JEOL E-beam lithography systems. Working at these consoles sometimes requires prolonged, focused observation of the monitor to ascertain electron beam focus conditions or other system parameters. In the course of receiving / shipping / installing new machine components this position may occasionally require the lifting of objects up to 40lbs.

**Working Environment:** Much of the time is spent working in a cleanroom environment where cleanroom gowning (head to toe) must be worn. Extended periods of time will be spent under yellow lighting conditions. Long hours may occasionally be called for to run a given process under development from beginning to end with minimal interruptions or delays, as required by the process technology under development. There are deadline pressures, while at the same time there is a demand for thoroughness, accuracy and acute attention to detail. Much of the work can be accomplished sitting in a comfortable position with frequent opportunity to move about.