Journal of Clinical Chemistry and Laboratory Medicine

OPEN ACCESS Freely available online

Perspective

Focused Ion Beam (FIB) Systems Role in Clinical Research and Its Development

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DESCRIPTION

The nature of biological materials and their interaction with electron and ion beams make it difficult to analyse cellular and biological structures at high resolution. Nonconductive samples simply result in charge, which restricts the ease and quality of imaging. To see how tissues, cells, and substrates interact, cross-sectional analysis is very valuable. It becomes more important to introduce their capabilities as electron microscopes become more sophisticated and popular in research facilities. The site-specific analysis, deposition, and ablation of materials using focused ion beam, commonly known as FIB, is a technology utilised mostly in the semiconductor industry, materials research, and increasingly in the biological area. A tool used in science called a FIB setup looks similar to a Scanning Electron Microscope (SEM). FIB systems can be compared to an ion beam that can be used to deposit, scan, and mill (sputter) materials on the micro- and nanoscales.

The electron columns of scanning electron microscopes are frequently merged with the ion columns of FIBs. Over the past ten years, there has been a rapid advancement in the utilization of Focused Ion Beam (FIB) techniques in the biological sciences. The focused ion beam, originally a solely dedicated ion beam instrument, is now typically used in conjunction with a wide range of complementing tools, such as dual-beam SEM, environmental SEM, energy dispersive X-ray spectroscopy, or cryogenic options. All of these improvements have helped to advance the use of focused ions beams in the investigation of biological matter and biomaterials. With the aid of this complete tool, biomaterials, cells, and their interfaces can be regularly scanned, examined, or ready for methods like Transmission Electron Microscopy (TEM). The dual beam FIBSEM apparatus was made possible by the inclusion of an electron column as a secondary column to the focused ion beam system. This technique allows for the simultaneous milling and imaging of materials by co-focusing an ion and electron beam on the sample. Other technologies, in addition to electron imaging, have been added to the FIB to increase analytical power. Cross-sectional samples can be used for elemental analysis with EDX to gain further knowledge. In order to improve analytical power, the FIB has been equipped with additional technologies in addition to electron imaging. To understand more, cross-sectional samples can be used for elemental analysis with EDX. The conventional method for preparation of TEM samples in the life sciences has always been ultramicrotomy. TEM samples are frequently made using a focused ion beam for higher resolution investigation. The special method makes it possible to create TEM lamellae from bulk materials. Samples can be created in a variety of ways, including cross-section, plan view, H-bar, *ex situ*, or direct liftout. Focused Ion Beam (FIB) is a tool that can be used in a number of industries, from nano-electronics to medicine, to create, trim, analyses, and characterize materials on microscopic and nano scales. Due to a variety of factors, gallium (Ga) is currently the LMIS (liquid-metal ion source) that FIB instruments most frequently use. Ga has a low melting point of 29.8 °C, which allows it to persist in a liquid condition close to room temperature, minimal volatility and also low vapour pressure. Future focused ion beam technology will make it possible to fully treat and evaluate biological samples at any length scale. Instruments that are well-maintained and equipped enough might make this possible. Investigating biological samples has never been easier due to the focused ion beam device.

CONCLUSION

The Focused Ion Beam (FIB) system is an important device for comprehending and modifying the nanoscale structure of materials. This system can serve as an imaging, analytical, and sample manipulation tool when combined with an electron beam to form a DualBeam. From FIB-prepared TEM samples that maintain their interfacial contact are underformed in their cellular structure, high-resolution structural and chemical information is accessible. Today, it is possible to see interactions between cells and surfaces from inside the cell, which is essential for comprehending and subsequently developing biomaterials. The dual beam FIBSEM devices provide comprehension of structures and interfaces in three dimensions. Last but not least, developments like the inclusion of cryocapabilities are making it possible to analyses biological matter in as much of an intact state as possible, adding fresh information to previously studied specimens.

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Received: 02-Sep-2022, Manuscript No. JCCLM-22-19353; **Editor assigned:** 5-Sep-2022, Pre-QC No. JCCLM-22-19353 (PQ); **Reviewed:** 19- Sep-2022, QC No. JCCLM-22-19353; **Revised:** 26-Sep-2022, Manuscript No. JCCLM-22-19353 (R); **Published:** 03-Oct-2022, DOI: 10.35248/JCCLM.22.05.242

Citation: Grandfield H (2022) Focused Ion Beam (FIB) Systems Role in Clinical Research and Its Development. J Clin Chem Lab Med.5:242