



6th International Conference on Nanotechnologies and Biomedical Engineering
Proceedings of ICNBME-2023, September 20–23, 2023, Chisinau, Moldova - Volume 1:
Nanotechnologies and Nano-biomaterials for Applications in Medicine

Patterning Nanoelectronic Devices Using Field Emission Scanning Electron Microscope

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https://doi.org/10.1007/978-3-031-42775-6_31

Abstract

Many advances in fabrication processes at micro and nanoscale in the past two decades were possible due to scanning electron microscopy, which is now an indispensable tool for analyzing and fabricating new nanostructures and nanomaterials. The development of very efficient in-lens detectors for SEM and the capability to use low energy electron probes are the gateway to the revelation of new features and new properties of nanomaterials that have been hidden by the use of high accelerating voltages and large interaction of volume, in the high-resolution SEM. Electron beams have been used for lithography for decades and pattern generators can be fitted to all modern SEMs, converting them in very powerful nanolithographic tools, without degrading or limiting their imaging capabilities. The SEM became a very versatile tool for micro and nanofabrication, the same equipment used for fabrication being used to view the resulting nanostructures.

Electron Beam Lithography (EBL) is one of the highest resolution lithographic technologies and a key technique for fabrication of nanoelectronic devices, allowing direct patterning of structures with critical dimensions down to 10 nm [1]. Apart of resolution, a very important point of EBL is that it can be easily implemented in a research laboratory by converting a scanning electron microscope (SEM) for lithography with an external pattern generator. To illustrate the patterning capabilities of electron microscopy, in this review we describe the EBL based fabrication processes of some nano-devices like field effect transistors on graphene and other 2D materials.

Keywords: nanoelectronic devices, patterning, electron microscope



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