Reproduction of Oligophenylene Vanillin Nanowires Using Focused ion Beam Nanolithography (FIB) (Below 100 nm - 10 nm Range)

Dr.Afshin Rashid , Assistant Professor

Faculty member Islamic Azad University of Science and Research Branch, Tehran

- **Abstract:**

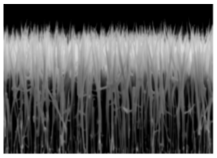
- Among the physical properties of oligophenylene vanillin nanowires , we can mention their electrical, photoelectric, and mechanical properties. .

- **Keywords:** Nanochips , Nanophotonics , Nanoelectronic , Nanospintronics , Nanowires

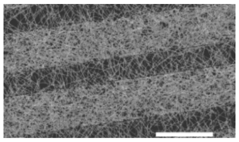
• Introduction

Nanowires (SiNWs) have high mobility and surface-to-volume ratio, which makes them easy to control using a weak electric field. These one-dimensional nanostructures are made of nanowires with diameters in the nanometer range and lengths exceeding micrometers. The fabrication of nanowires from regular one-dimensional arrays has been carried out using different physical and chemical methods. Methods such as the use of electron beam or lithography, irradiation with heavy ions, lasers, chemical and electrochemical methods such as hydrothermal and spontaneous assembly methods used to make mold membranes can also be used . The fabrication of one-dimensional nanostructures such as oligophenylene vanillin nanowires by electro -deposition involves three general steps: first, the fabrication of a porous mold as a suitable substrate and framework for the deposition of nanowires, second, the growth of nanowires along the mold holes, and third, the removal of the mold and separation of nanowires from it.

The properties of nanowires are directly dependent on the surface characteristics of the mold, such as the size distribution of the pores, the density of the pores, and the surface area of the nanopores. To control the properties of oligophenylene vanillin nanowires, it is necessary to consider the parameters that affect the formation and optimization of the diameter of the pores and the thickness of the mold.



Focused ion beam nanolithography sources were mainly based on nanotechnology due to its stability and ease of use . Focused ion beam scanning on the surface of a material removes material with a desired pattern and with high nanoscale precision, and for the conceptual design of focused ion beam nanolithography, it uses and integrates similar components: sources, extraction and acceleration, optics, scan coils, sample stage, electron detectors, etc. Interestingly, focused ion beam nanolithography equipment provides the user with all the imaging, nanostructural and analysis capabilities of both technologies in a single platform. For this reason, focused ion beam technology has become very popular for performing specific tasks such as cross-sectional imaging, preparation of nanodevice layers, nanopatterning of materials and circuit editing. Focused ion beam nanolithography is able to directly remove material without the use of large amounts of resistors. As a direct nanolithography method, the number of processing steps is minimized compared to other methods. Focused ion beam nanolithography , as a sequential nanolithography technique, is inherently slow and its throughput is much lower than that of various techniques, and the Ga^{+} -based liquid metal ion source has become the most widely used source type in focused ion beam nanolithography equipment. However, in recent years, new developments in sources such as gas field ion sources , plasma sources , and metal alloy sources are the next step in terms of resolution or power. Since the ion-matter interaction is stronger than the electron-matter interaction, it is possible to cause harmful effects on the remaining material and change its physical and chemical properties.Important but key applications for focused ion beam nanolithography technology have been found in the semiconductor industry, in nanotechnology, and in materials science. And the deposition by focused ion beam nanolithography requires a gas injection system to produce a local deposit from a precursor material delivered in the form of a gas, with the separation of the precursor caused by the appropriate radiation in the nanoelectronic devices . The main advantage of this technique is the selective growth of a material in a region of interest in a single step. Due to the high resolution of the focused ion beam nanolithography technique , the deposits can be grown with high lateral resolution , but with much less damage to the substrate due to the low linear motion of electrons compared to ions. In contrast, the growth rate and metal content of the deposits generally favor focused ion beam nanolithography.



The physical properties of oligophenylene vanillin nanowires include their electrical, photoelectric, and mechanical properties.

References :

- Jiříčková, A., Jankovský, O., Sofer, Z., & Sedmidubský, D. (2022). Synthesis and applications of graphene oxide. Materials, 15(3), 920.
- Idumah, C. I. (2022). Recent trends in MXene polymeric hydrogel bionanoarchitectures and applications. Cleaner Materials, 5, 100103.
- Zhang, J., Qin, Y., Pambos, O. J., Zhang, J., Chen, S., Yu, Z., & Abell, C. (2021). Microdroplets confined assembly of opal composites in dynamic borate ester-based networks. Chemical Engineering Journal, 426, 127581.
- Wang, M., Bai, J., Shao, K., Tang, W., Zhao, X., Lin, D., ... & Ye, J. (2021). Poly (vinyl alcohol) hydrogels: The old and new functional materials. International Journal of Polymer Science, 2021(1), 2225426.
- Pei, S., & Cheng, H. M. (2012). The reduction of graphene oxide. Carbon, 50(9), 3210-3228.