Overview of Quantum Nanostructures by the Molecular Beam Epitaxy

Dr. Sarfraj khan

G.D.College Department of physics, Begusarai, LNM University, bihar

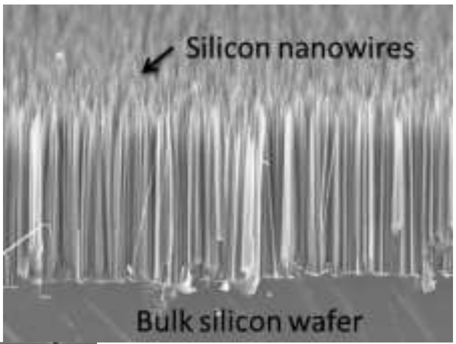
Abstract

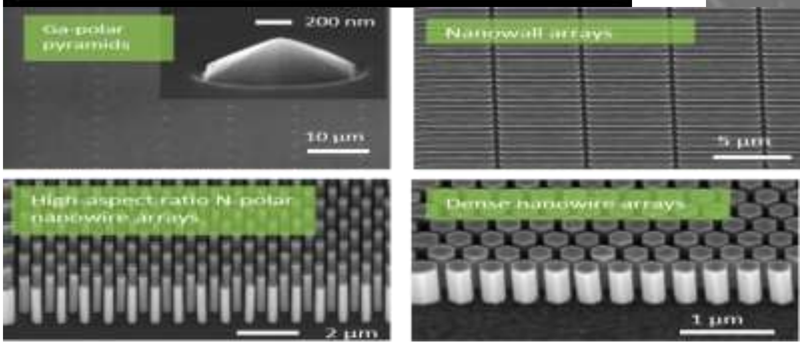
One of the most efficient prosperity of molecular beam epitaxy is the nano- structure that permitted the formation of automatically flat and contingent hetro interface. Nanowires is one nanometer made by molecular beam epitaxy play a significant role in field of quantum computer and Nano robots are very tiny mechanics which are planned for a specific function or tasks repeatedly with some accuracy at nanoscale dimension. Recent advances on molecular beam epitaxial development and feature of nanowire hetro structures. Molecular beam epitaxy (MBE) used the interactions of atom on a heated crystalline substrate under ultra-high vacuum (UHV) conditions to grow nanoscale layers. MBE offer the possibility of growing structure under well define conditions. In recent new fields have been added: crystalline of as- grown low dimension hetro structures, mainly quantum wires and in- growth control of the MBE crystallization processof strained-layer structures.

Key words: MBE, Quantum wires, UHV, Nano robots.

Molecular beam epitaxy (MBE) is an atomic layer by atomic layer crystal growth technique, based on reaction of molecular performed on ultra-high vacuum (UHV) environment. The team molecular beam epitaxy wasused for the first time in 1970(c h o et al. 1971). The term epitaxy is composed of the Greek word epi meaning akin or upon and taxis meaning arrangement or order. Epitaxy refers to ordered growth of crystalline layer on other crystalline layer with the same crystal arrangement. Therefore a critical issue in epitaxial crystal growth in the surface condition of the starting crystals and the subsequent layers as they are being grown. Molecular beam epitaxy is unique in two respects:it is performed in UHV and it is based on reaction of atomic and molecular beam with a crystalline surface, relying on kinetic process such as absorption desorption, dissociation migration reaction and incorporation.

These features allow real time in situ monitoring and control during the substrate preparation and film growth to ensure the best condition for a stoichiometry and epitaxy. Consequently ,although MBE is a form of vacuum evaporation crystal growth method by employing atomic or molecular beam in a UVH environment, which allow precise control of composition growth condition high purity and real time in situ monitoring.Since the growth is governed by surface kinetic at relatively low substance temperatures, material and dopent inter diffusion can be kept to a minimum. Therefor MBE is capable of producing extremely high purity and highly crystalline thin film netero structure with precise control over composition, doping and interfaces in the fraction of nanometer range in the growth direction with precise lateral uniformly. The sub nanometer control and precise in the structure and doping afforded by MBE, its variants and MOCVD leads to an enormous flexibility, in tailoring functional Behaviour of thin-flim structures. This is referred to as bandgap engineering or band structure engineering. MBE is widely employed to grow semiconductor, metal, insulator and ceramic thon film. It has brought about remarkable advances in semiconductor thin-film technology in particular. Hetrostructure with extremely adrupt composition and sharp interfaces or precisely graded composition and compositional superlattice with: periods of only a few inter-atomic. The initial work on MBE growth was primarily focused on As/GaAs. There were two major factors in the development of molecular beam epitaxy from the late 1960 to the mid-1970s. First was the application of in the situ, real-time surface analysis techniques to study the reaction of collimated beams technologies to study the reaction a collimated beam of As2 and gallium on heated GaAsin UHV. Pulsed beam mass spectrometry established conditions for a stoichiometry and reflection high energy electron diffraction (RHEED) established the understandingand optimization of processes involved in the substrate preparation and proper substrate temperature for epitaxial growth. Second was the substrain focus on applying and refining the MBE growth system and technique for the recelization of epitaxial hetrostruct Recently, I presented on analytical model for nanowires growth kinetics in the MBE techniques and also discuss about properties of nanowires. Mechanical properties: The spacious amount of gain boundaries in a bulk material are made of nanoparticle, which allowed extending the gain boundaries sliding lead to high flexibility. Magnetic properties: In the magnetic properties of nanoparticle the energy of magnetic anisotropy might be that superfine that the vactor of magnetization fluctuates thermally, such meterials are free from reminisce and coercitivity. Catalytic properties: Due to largesurface of area, the nanoparticles which are made of transitions materials oxide exhibits motivating catalysis properties. In some of the special cases may be improved and additional specific by decorating these particles with gold and platinum duster. Optical properties: In optical property the allotment of non-agglomerated non-particles in a polymer are used to the directory of refraction. In addition, such a procedure may manufacture material with nonlinear optical properties or visible property.The theory of nanowires growth was the developed to large parts by the grope of V.G Dubrovskii and F. Glas. Starting in 2004, Dubrovskii tried to explain his observation e.g. the development of nanowires radius, byexpanding the growth model of Givargizov and Chernov.Due to the factthat the model just account for the Gibb-Thomson effect and direct collection of imaging material by the droplet, it could, when related to the growth of GaAs nanowires at first just explain the results achieved very Ga-rich growth condition where the droplets is highly super structured and the diffusion contributions to the nanowires growth rate arenegligible.





To achieve a high degree of simple purity,the growth chamber is evacuated to ultrahigh vacuum(UHV,10^-7 Torr TO 10^-12 Torr). For a typical growth chamber with a diameter of approximately 1 meter a pressure in the 10^-4 Torr range is needed to ensure that the mean free path of the evaporated materials is larger than the distance between effusion cells and sample,so that the material can reach the simple without being affected by residual gas molecules. The UHV guarantees that almost no residual gas molecules condense on the substrate surface and are unintentionally incorporated is the crystal during the growth process. The growth process in MBE is usually an epitaxial process i.e., the growth structure adopts the crystal phase of the substance. To monitor the growth process and the simple quantity, surface sensitive method like RHEED are used. Besides the fact that RHEED can provide information about the surface roughness is can also be used for nanowires crystal structure investigation. The MBE system used for the simple fabrication is modified for veeco generation-2 systems. The MBE system consists of an entry chamber, a buffer chamber and growth chamber,with are separated from each other by gate values. The entry chamber is equipped with a heat coil for the degassing of the substrance and a cryogenic pump which provide a pressure down to 5×10^-9Torr. The buffer chamber is equipped with the heat station for the single sample holder. Here, the simple holder is heated to 400 degrees celsius to remove the last residual of water and other vaporable contaminations. The vacuum in the buffer chamber is generated with the cryogenic pump and can reach pressure below 10^-10 Torr. The growth chamber is equipped with aheatable manipultor an ion gauge several effusion cells, a large cryogenic pump a titanium sublimator, a pyrometer port and a RHEED system.

In present GaN nanowires grown by molecular beam epitaxy, some properties are included the absence of residual strain, exclusion of the most extended defects, long photoluminescence lifetime, low surface recombination velocity and high mechanical quality factor.

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