

In the proposed project a possibility of fabrication of a miniature transmission electron microscope (TEM) using MEMS (Micro-Electro-Mechanical System) technology will be examined. Classical TEM microscopes are devices that allow extremely precise imaging of test samples (resolution <1 nm), but they are very large, expensive and can only be used in specialized laboratories. Many research centers around the world work on dissemination of electron microscopes. It would be very valuable if electron microscopes spread like recently optical microscopes and digital cameras.

The development of microelectronics and microengineering technologies have enabled miniaturization of many devices. Modern cars and cell phones are full of miniature sensors and actuators. Theoretically, it appears possible to apply the modern technologies to realize a miniature electron TEM microscope. Literature describes the first attempts of miniaturization of the individual components of the microscope, but this is a fairly new area of interest and one should still carry out many basic research on its construction and technology. Moreover, up to now nobody has tried to assemble all the components on one chip, mainly due to the lack of compatible technology and method of generation of high vacuum inside a very small volume.

The aim of the project is to develop all the elements of the electron microscope in a form of miniature MEMS devices and their full integration on one chip. As a source of electrons a silicon field emission cathode coated with carbon nanotubes will be used. The field emission cathode will be connected to the electron optical column consisting of a series of electrically isolated silicon electrodes, which will control the focusing of the electron beam on the studied sample. The last part of the electron optical column will be an observation microchamber consisting of very thin, permeable for electrons dielectric membranes. The tested sample and the detector will be located above the membrane. For generation of high vacuum inside the miniature microscope, a recently elaborated by the authors of proposed project, MEMS micropump will be used.

The miniature electron microscope on-chip will be used for study properties of solid and hydrated samples (biological). Obtaining contrast images with good resolution and with the possibility of tracking the dynamics of changes in the observed sample would be very useful, for example for detecting of cancerous changes in cells.