Toward new integrated high-vacuum MEMS instruments

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In the recent years, technology of MEMS vacuum instruments is intensively developed. This is possible thanks to the experience in the production of MEMS devices and to advances in miniaturization of Vacuum Nanoelectronics devices. The research took off from the development of various types of miniature, field-emission cathodes with array of sharp microtips, which replaced the thermal cathodes. Modern microelectronics technologies, newly developed nanomaterials and new packaging techniques have been used.

As a result, such instruments as flat-panel displays, first miniature microwave tubes and X-ray sources have been produced. At present, work is going on miniaturization of such devices as mass spectrometers, ionizers, sensors, and free electron lasers containing field-emission cathode. Most of these devices to work properly requires a high vacuum. Currently used vacuum sealing technologies do not ensure vacuum higher than 10^{-3} hPa in the long term.

The problem of obtaining a high vacuum inside a volume smaller than 1 cm^3 is still an unsolved technical problem. In the speech will be presented a new method of active microvolume pumping using the ion-sorption MEMS micropump. It allows to create vacuum higher than 10^{-5} mbar and gives possibility of full integration with the pumped miniature device. This opens up a new path for the further miniaturization of vacuum devices using the MEMS technology. The first concepts and first examples of integrated vacuum MEMS devices will be presented. This solution become interesting for the first European centers that offer joint research on development and implementation of MEMS vacuum instruments.

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