MEMS INFINITY – MULTIPLE USE MEMS ADAPTER TO MEASURE FIELD EMISSION IN VACUUM ENVIRONMENT

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ABSTRACT

For more than 10 years, high vacuum MEMS devices were developed at Wroclaw University of Science and Technology [1]. Usually, during the development stage the systems and parts of the systems, e.g. electron emitters, are tested in vacuum chambers. However, to test the final device, all technological processes needed to be performed, including anodic bonding of the whole structure to ensure vacuum sealing of the device. This process is difficult and sometimes leakages are encountered, so the final device cannot be tested. Moreover, the anodic bonding is final, so there cannot be any changes in the structure of the device.
In this work, we present our solution of a MEMS structure with a vacuum adapter and a valve that can be placed on a desk to do easier measurements and tests, e.g. field emitters in the setup of a final device. We called it MEMS Infinity because it is a compact sized portable adapter, which can be reusable, that allows carrying out tests on manufactured silicon field emitters. Minuscule dimensions of this adapter allow measurements in a restricted space environment, and it also offers an easy way to replace the field emitter that is being studied, which improves replicability of measurements; moreover, it saves time during assembly of the measured structure. The components of the adapter, as well as the silicon tips that were tested with it, were manufactured using wet anisotropic silicon etching in aqueous solution of potassium hydroxide, similarly to that in [2]. As an electron detector, a flat silicon structure was used [3]. The structure of MEMS Infinity was integrated using anodic bonding, which ensures preservation of structural integrity and minimizes outside environmental factors that may significantly affect the occurrence of field emission phenomenon, such as accumulation of humidity, furthermore specially manufactured efferent canals, allowing for formation of vacuum inside the structure of MEMS Infinity in order to test the phenomenon of field emission. Further development of the vacuum adapter in the case of unambiguous as well as nondeviant from expected results would be based on further miniaturization while conserving the simplicity of cable connections.

References

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