MODULAR 3D-PRINTED MEMS PLATFORM FOR A FIELD EMISSION SCANNING ELECTRON MICROSCOPE

Janusz Rozum, Damian Opiela, Michał Krysztof
Wroclaw University of Science and Technology, Wybrzeze Wyspianskiego 27, 50-370 Wroclaw
E-mail of corresponding author: 278017@student.pwr.edu.pl

ABSTRACT

A novel approach to MEMS vacuum device design is presented, addressing limitations of conventional fabrication techniques, particularly anodic bonding, which is prone to leakage thus insufficient for maintaining the high vacuum required for stable field emission. The system is based on a MEMS scanning electron microscope architecture developed at Wroclaw University of Science and Technology [1].
A key limitation of such devices is the difficulty of testing fully integrated systems. To overcome this, a modular architecture is introduced, replacing permanent wafer bonding with a mechanically assembled structure that enables direct access to individual functional layers.
The proposed system combines a high-precision DLP 3D-printed housing with a custom PCB interface. Integrated sockets ensure precise alignment of the field emitter, extraction gate, and octupole electrode. The key contribution is a reconfigurable MEMS vacuum platform that eliminates anodic bonding [2] while enabling independent testing and replacement of components, which cannot be achieved in conventionally bonded MEMS architectures.
Experimental observations show that reduced vacuum accelerates emitter degradation, confirming the critical role of vacuum integrity. The proposed architecture provides a practical platform for iterative development of MEMS-based vacuum electronic devices.

References

[1] Białas, T. Grzebyk, M. Krysztof, A. Gorecka-Drzazga, Signal detection and imaging methods for MEMS electron microscope, Ultramicroscopy, 244 (2023) 113653.
[2] J. Dziuban, Bonding in Microsystem Technology, Advanced Microelectronics series, Springer 2006, The Netherlands.