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Direct fabrication of porous 3D microstructures on silicon wafers for MEMS applications

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A new automated method for the fabrication of functional 3D porous structures directly on planar standard silicon wafers has been developed [1,2]. A typical approach comprises the filling of a mold pattern with micron sized particles of the desired material, and their fixation via atomic layer deposition (ALD). It has been demonstrated that it is possible to manufacture for example micromagnets from NdFeB powders that can be used for energy harvesting.
In order to achieve smallest dimensions and highest filling factors, the utilization of dry powder as the starting material is beneficial. The new approach utilizes the superimposition of high- and low frequency oscillations for particle mobilization in order to achieve optimum mold filling. Additionally, rubber balls are applied for densification of the powder packing.
For verification of the application properties, micromagnets were created from 5 µm NdFeB powder on 8”Si wafers, using the novel automated mold filling technique, as well as an existing manual one for benchmarking purposes. Subsequent atomic layer deposition were utilized to agglomerate the loose NdFeB particles into rigid microstructures. The magnetic properties and inner structure of the NdFeB micromagnets were investigated. It is shown that the novel automated technique outperforms the manual one in major terms. In addition, examples for further materials and applications will be briefly discussed.

Participation

In-Person

References

[1] German Patent DE 10 2020 209 525 A1.
[2] C. Kostmann; T. Lisec; M. T. Bodduluri; O. Andersen; Micromachines, 2021, 12, 1176.

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Primary authors: ANDERSEN, Olaf (Fraunhofer IFAM Dresden); Mr KOSTMANN, Cris (Fraunhofer IFAM Dresden); Dr LISEC, Thomas (Fraunhofer ISIT); Prof. WEISSGÄRBER, Thomas (Institute of Materials Science, Chair Powder Metallurgy, Technical University of Dresden, Germany)

Presenter: ANDERSEN, Olaf (Fraunhofer IFAM Dresden)

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