Reaching silicon based MEMS sensors and actuators performances with 3D printing technologies

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The sensor and actuator miniaturization obtained with MEMS an NEMS technologies **offers the possibility to reach an unprecedented resolution in sensitivity and displacement**. These very high detection resolutions are related to the combination of two factors: a small device mass and a high structure rigidity. The main drawback of MEMS is represented by the highly complex, multi-steps, and expensive fabrication processes. Several alternatives fabrication processes have been exploited, but they are still limited to large dimension and poor sensitivity and resolution.

Here we report the fabrication of rigid MEMS and NEMS sensors and actuators with high sensing and displacement performances by a 3D printing approach. After a thermal step, we reach complex geometry printed devices composed of ceramic structures with high Young's modulus and low damping showing performances in line with silicon-based MEMS devices. We demonstrate the possibility of rapid fabrication of NEMS resonators for mass sensing and piezoelectric MEMS sensors and actuators that present an effective alternative to semiconducting devices.