Electroforming of nickel and its alloys for MEMS and μ–tools

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Microelectromechanical systems (MEMS) are the basis of many rapidly growing technologies, because they combine miniature sensors and actuators with communications and electronics at low cost. Commercial MEMS fabrication processes are limited to silicon-based materials or two-dimensional structures.

Although numerous MEMS devices are used in the automotive, communications and chemical industries, and their influence is expected to grow with the increased interest in micro-machines for optoelectronics and biotechnology, the processing limits the number of materials that can be used, and therefore limits their functionality. In electrochemical deposition (ECD), dissolved species are deposited as a film by reduction at a conducting surface. A non-conducting mould, together with conductive sacrificial layers, is used to guide the deposition only onto select areas. This allows the fabrication of tall structures (and high aspect ratios).

In this work, the fabrication technology makes use of electrodeposited nickel and its alloys layers as the structural material for the production of MEMS devices and multilayer μ-tools. Some of the advantages of using electroplated metals instead of poly-silicon are significantly lower processing, temperature, higher deposition rate, post process compatibility and low residual stress of the mechanical elements.

Results on the electroforming of nickel, nickel-cobalt and nickel-cobalt-phosphorus alloys will be presented. Preliminary results about the fabrication of an electrostatic comb-drive resonator, together with its resonance characterization and quality factor, will be discussed.