Fabrication of micrometer ferromagnetic parts through an optimized combination of lithography and electrodeposition

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The micro-manufacturing of functional parts is opening the path to new and advanced applications (e.g. micro-electro-mechanical systems, MEMS) in key technological sectors as electronics, aerospace and medical. The combination of lithography and electrochemical methods allows for the fabrication of unique components with tunable functional properties accompanied by high dimensional and replication accuracies [1,2].

In this work, micrometer size parts made of the ferromagnetic FeCo alloy (see example of one of these parts in Fig. 1) were manufactured by an optimized combination of lithography and electrodeposition steps. Firstly, the substrate was covered by a thin gold layer to make the electrical contact required for the electrodeposition step. The photoresist moulds were fabricated by lithography in a second step (Fig. 1a), which were filled with the alloy by electrodeposition. For all the grown parts with different shapes, it was observed that the FeCo alloy replicated the shape of the moulds, covering homogeneously the exposed surface (Fig. 1b). The stoichiometry of the grown alloy and the resulting magnetic properties can be tailored by tuning the electrolyte and electrodeposition parameters. This approach allows for fabricating hundreds of components in each run (see inset in Fig. 1b), amount that is industrially scalable leading to a drastic reduction of the unit cost of each component.

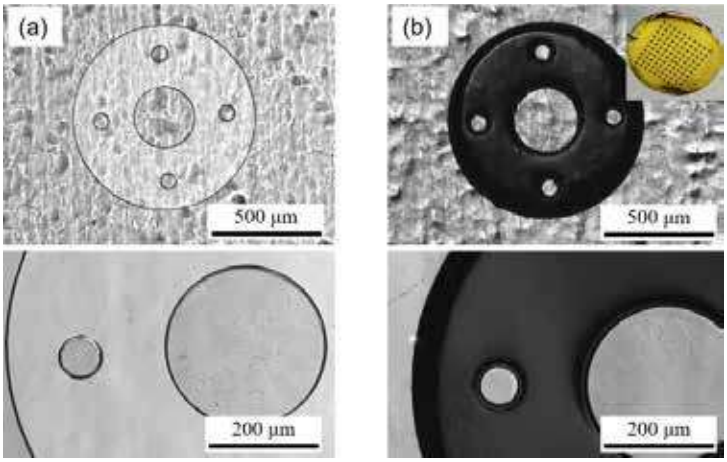

Figure 1. Optical microscope images of a photoresist mold prepared by lithography (a) before and (b) after filling it with the ferromagnetic FeCo alloy by electrodeposition. Inset in (b) shows an image of the complete wafer (1 inch in diameter) with one hundred parts produced by the above mentioned process.

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