Fabrication of Patterned Arrays with Alternating Regions of Aluminum and Porous Aluminum Oxide

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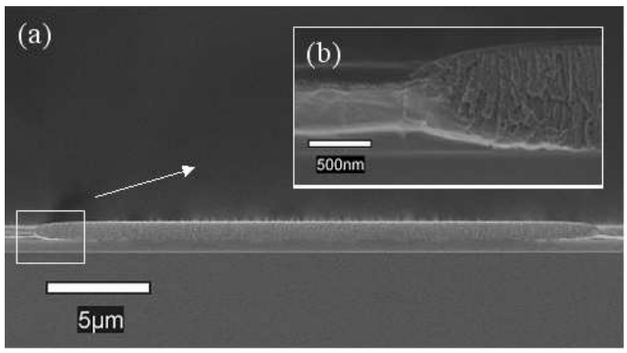
Anodic aluminum oxide (AAO) arrays are self-ordered porous structures, which are suitable for many technical applications. These arrays exhibit the hexagonal pore arrangement, a very high aspect ratio of 1000 (pore length to pore diameter) and a high pore density of 10^{11} pores/cm^2. Although AAO arrays have been demonstrated to provide the basis for the fabrication of nanostructures, the commercial applications of this material have been limited due to the low mechanical strength of aluminum oxide and the difficulty in integrating this material into micro-fabricated devices.

In this presentation, a procedure is described for the fabrication of patterned AAO arrays by using a dense barrier aluminum oxide layer as the anodization mask[1]. This fabrication procedure includes the following steps. The aluminum film is patterned with a photoresist and then briefly anodized at a high voltage. The high voltage produces a thin, dense layer of barrier aluminum oxide layer. The photoresist is then removed and the aluminum film is again anodized at a low voltage to grow porous aluminum oxide. The dense barrier aluminum oxide acts as an anodization barrier thus leaving the underlying aluminum intact. Using this procedure, we are able to fabricate AAO arrays on silicon wafers, which consist of alternating regions of porous aluminum oxide and aluminum metal perpendicular to the silicon substrate.

Figure 1 (a) shows a micrograph of a patterned feature with both porous aluminum oxide (middle) and aluminum covered by dense barrier aluminum oxide (left and right). Figure 2 (b) is the cross sectional view of the interface between the porous anodic aluminum oxide and aluminum with the protective layer of dense barrier aluminum oxide on the top.

Nano-structures with alternating regions of aluminum and porous aluminum oxide with a low dielectric constant are attractive for the designs of novel interconnect systems in advanced IC technology.[1,2] In addition, this structure allows for the integration of AAO into micro-fabricated devices such as pre-concentrators, heat sinks, nanofluidic devices, reinforced membranes for separations and micro-reactors, and gas diffusion electrodes for micro-power sources.



References

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