Ion Beam Technologies for Sensor Manufacturing

Karl Gündel [1], Marcus V. Daniel [1] and Matthias Nestler [1]

[1] *scia Systems GmbH, Annaberger Str. 240, 09125 Chemnitz, Germany*

For the structuring of MEMS substrates, a variety of etching technologies is used, each with individual advantages and thus for different applications. scia Systems provides vacuum equipment for dry etching processes, such as ion beam etching (IBE) as well as reactive and chemically assisted ion beam etching (RIBE/CAIBE) to meet these applications.
Ion beam etching or milling (IBM) with the scia Mill 150 uses argon ions to physically remove material from surface of substrates or wafers. The ion beam source made by scia Systems allows a precise tuning of ion density and ion energy. Due to ion bombardment, the argon ion beam milling allows the removal of all materials, including precious metals, used in complex layer stacks in opposite to chemical etching. Additionally, in contrast to reactive ion etching (RIE), the ion beam milling with inert gases, like Argon, suppresses any after-corrosion effects, which would lead to an increased resistivity when processing metals. By operating with a helium backside wafer thermal contact the substrate temperature is kept low. This allows processing with photoresist masks on the sample and etching of temperature sensitive materials. By using a secondary ion mass spectrometer (SIMS) the precise measurement of sputtered atoms can be realized and an exact endpoint detection of the etching is possible. Even the measurement of sub-nm thick layers is achievable.
We will present typical applications of IBM, like the structuring of tunnel-magneto-resistance (TMR) sensors (Fig. 1) and micro-structuring of optical surfaces with RIBE using fluorine based gases.

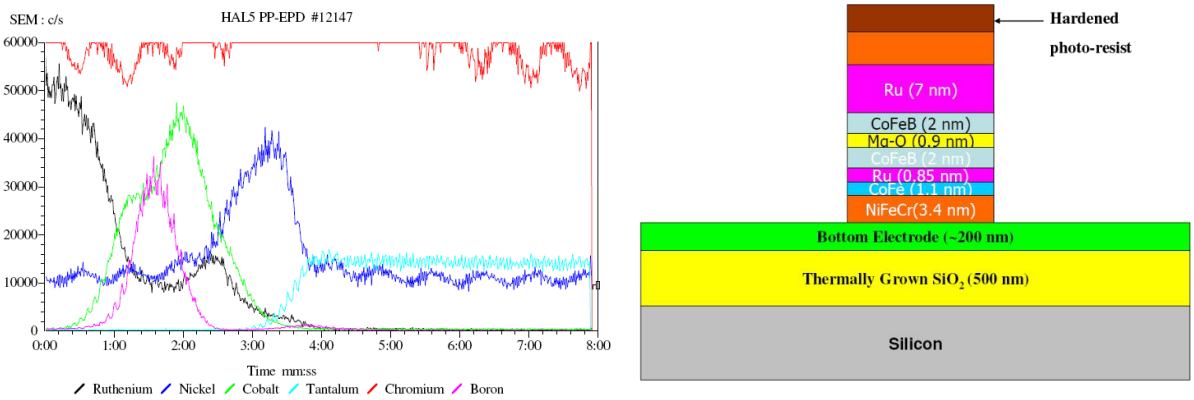

Fig.1: Schematic representation of structured tunnel-magneto-resistance layer stack (right, [1]) and the corresponding SIMS signal during ion beam etching (left)

[1] Pandharpure, Shrinivas, Thesis. Rochester Institute of Technology. "*Process development for integration of CoFeB/MgO-based magnetic tunnel junction (MTJ) device on silicon*" (2007).