Simple, and Highly Preservable Gold-grafted Nanostructure Silicon Detection Platform

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Nanoscale silicon (nSi) technology have been used in high sensitivity laser desorption/ionization MS analysis as well as electrochemical sensing. The nSi-MS is a matrix-free approach because the organic matrix in conventional MALDI-MS is replaced by the high surface-to-area ratio nanoscale porous silicon surface. In addition to the MS analysis, electrochemical sensing can also apply to the nSi platform for the pre-screening purpose. An important issue in using the nSi-MS platform is the chip preservation and stability. Thus, in this conference presentation, we present MS and electrochemical analysis as well as sample preservation on gold-graft nSi surface. Glucose and model peptide was used as proof-of-concept.

The gold grafted nSi surface was fabricated by one electrochemical etching and two electrode-less deposition procedures. The silicon wafer was deposited with gold nanoparticles by first electrochemical deposition step. Then, the Au-coated silicon wafer was immersed in hydrofluoric acid to electrochemically etch the silicon surface and create silicon nanostructures (Fig. 1). The silicon nanostructures were then subject to the second electroless-grafting process to graft the Au nanoparticles onto the silicon nanostructures for both enzyme free electrochemical glucose sensing as well as matrix-free MS analysis. Critical fabrication parameters such as the first electrodeless Au deposition time, etching time and second Au grafting time are investigated. Preservation of nSi-MS is then evaluated and the nSi-MS desorption/ionization efficiency was characterized by the MS signal intensity and signal-to-noise (S/N) ratio. Three different preservation conditions of room, inert gas (nitrogen) and vacuum storage were investigated. Because storage vacuum prevents the surface oxidation and water moisture absorption on the silicon surface. The nSi-MS signal intensity maintains with storage time. Other storage conditions like air, nitrogen will be reported in the conference. A simple vacuum oven to desiccation the nSi surface to remove the aqueous solution from the nSi surface to increase the surface wettability and also enhanced nSi-MS intensity. Fig 2 shows the nSi surface hydrophobicity increased under the vacuum oven desiccation which can restore the surface hydrophobicity to 120˚ equivalent to the native nSi surface.

Keywords: Nanostructured Silicon, Mass Spectrometry Analysis, Electrochemical Sensing, Vacuum desiccation

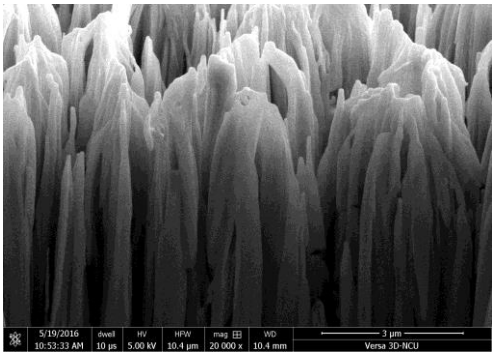

Fig. 1 FE-SEM image of silicon nanostructure fabricated from the first electroless Au deposition and metal assisted etching process

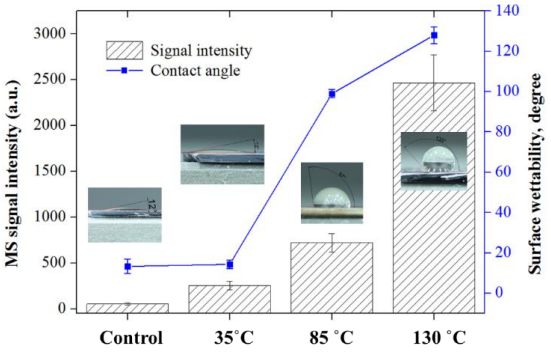

Fig. 2 nSi surface wettability and MS intensity for 1 month air storage nSi surface under vacuum oven desiccation at 35˚, 85˚ and 130˚C.