Single and multilayer metal contacts for chemically and thermally robust interconnects to porous silicon-based sensors

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In the present work, Al, Cr/Au, Ti, and Ti/Pt/Au metallisation schemes were investigated to examine their behaviour as contacts on the surface of porous silicon (PS) films, with a view to suitability for fabrication of thermo-resistive detectors. The choice of metal contact on the surface of PS films, to fabricate thermo-resistive detectors as well as other opto-electronic devices [1], is influenced by post-deposition processing steps such as exposure to HF during electropolishing and annealing at temperatures up to 600°C during surface passivation. The electropolishing process is required to electrically isolate the PS device from the underlying Si substrate while the surface passivation is required to achieve low electrical resistance and 1/*f* noise [2,3]. In this work, the survival of the metal contacts in HF was tested by immersing the fabricated structure in a 5% HF/DI based electrolyte for 5 minutes, while the ability of the contacts to tolerate 600°C passivation temperature in a rapid thermal annealing process was assessed using SEM characterisation.

The investigation revealed that as compared to other metals, the tri-metal layer combination of Ti/Pt/Au can survive HF as well as tolerate 600°C passivation temperature. The SEM view of the 600°C annealed Ti/Pt/Au contact on the surface of PS is presented in Figure 1. Contrary to Ti/Pt/Au, single layers of Al and Ti were etched in HF while bi-layers of Cr/Au survived. However, 600°C annealing of Cr/Au resulted in diffusion of Au in the pores, eventually contacting the Si substrate. In the tri-metal layer combination, Ti acts as an adhesive layer for Pt, Pt protects Ti from oxidising (allowing it to survive in HF), and the Au layer provides the main structural layer for the contact.

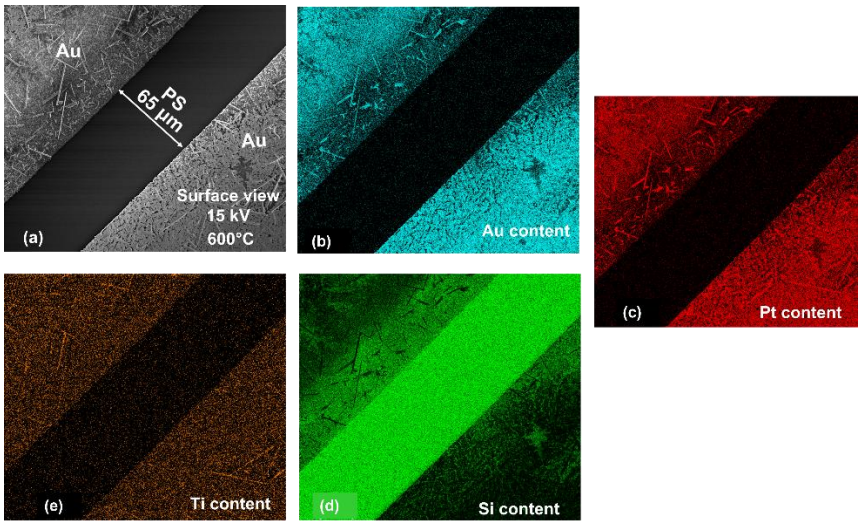

Figure 1. SEM view of the surface of Ti/Pt/Au deposited on PS annealed at 600°C; (b)-(e) presents EDS mapping showing Au, Pt, Ti and Si content in the structure presented in (a).

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[2] P. Sharma, X. Sun, G. Parish, A. Keating, Microporous Mesoporous Mater. 110767, (2020).
[3] P. Sharma, J. Dell, G. Parish, A. Keating, Microporous Mesoporous Mater. 324 111302, (2021).