Fabrication and characterization of Porous Silicon cantilevers for thermal sensors

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Minimization of thermal losses is one of the main requirements for the fabrication of arrays of thermal sensors, operating at high temperatures. As the dimensions of the thermal transducers are decreasing, the conductive heat flux to the substrate, due to the micro-hotplate material and geometry is becoming the dominant factor for heat losses. In order to reduce the thermal losses, alternative device designs, as well as new materials have to be used.

Porous silicon (PS) has been used for thermal isolation in silicon thermal sensor devices since the thermal conductivity of PS is significantly lower than that of bulk silicon (two or three orders of magnitude depending on the preparation of the PS layers). Closed and spider type PS micro-hotplates [1] (with two or four supporting beams) have been reported with improved thermal characteristics. Further minimization of thermal losses can be achieved with new micro hotplate designs, where the number of supporting beam is further reduced.

In this work, we describe a front-side micromachining process for the fabrication of PS cantilevers for thermal sensors. Suspended PS micro-hotplates in the form of cantilever with one supporting beam and with integrated heater have been fabricated and characterized. Very high temperatures with very low power consumption have been obtained, due to the very low thermal conductivity of porous silicon, which is comparable to that of thermal oxide and much lower from the conductivity of silicon nitride, typically used for thermal sensors applications.

[1] C. Tsamis, A. Tserepi and A. G. Nassiopoulou, "Fabrication of suspended porous silicon micro-hotplates for thermal sensor applications", Phys. Status Solidi (a) 197 (2):, p. 539-543 (2003)