

# Analysis of the Noble Metals on Silicon Wafers by Chemical Collection and ICPMS

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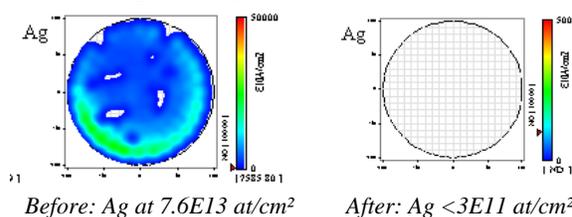
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## ABSTRACT

Recent technological evolutions in advanced microelectronic, in heterogeneous integration or in MEMS technologies have led to an increase of materials present in manufacturing clean rooms leading to new risks of wafers contamination [1,2]. Among these new elements, noble metals (Pt, Au, Ag, Pd, Ru, Os, Rh, Ir) represent high detrimental impact risks for wafers which imply their mandatory control on the wafer surfaces at lower levels than  $1E11$  at/cm<sup>2</sup> [3].

Currently, only the TXRF technique allows the measurement of noble elements with a relative good sensitivity (up to few  $E10$  at/cm<sup>2</sup> range) but also with significant uncertainties (15%-100% depending on levels). Usual sensitive (up to  $E7$ - $E8$  at/cm<sup>2</sup>) and accurate ( $\sim 20\%$ ) analytical techniques of metallic contaminants based on a chemical collection followed by their analysis with Atomic Absorption Spectroscopy (AAS) or Inductively Coupled Plasma Mass spectrometer (ICPMS) are not applicable for noble metals due to their high oxido-reduction potentials. Indeed, HF Vapor Phase Decomposition-Droplet Collection (VPD-DC) is inefficient whatever their chemical form (metal as ionic) [4] whereas Liquid Phase Decomposition with diluted HF (LPD) can be applied only to the collection of ionic species on thick silicon oxide surfaces.

In this paper, we have addressed the measurement of noble metals by a chemical collection coupled to ICPMS analysis. To achieve this goal, chemistries have been selected depending on elements and implemented on wafer by a liquid phase collection. The technique development was focused on Au, Ag and Pt noble metals and, was evaluated in terms of collection efficiency, low limit of detection and repeatability from intentionally contaminated wafers. Both ionic and metal forms of the contaminants have been studied through different voluntary contamination modes of wafers: spin-coating method (ionic form), electroplating method and Physical Vapor Deposition processes (metal form). The liquid phase collection and ICPMS analysis method developed leads actually to reach low limits of detection close to  $1E10$  at/cm<sup>2</sup> and good collection efficiencies ( $>90\%$  for Ag and Au; Pt on going) as illustrated by TXRF measurements presented in Fig.1 for silver



**FIGURE 1.** TXRF mappings of an Ag intentionally contaminated wafer by a physical vapor deposition before (left) and after (right) the liquid phase collection step.

**Keywords:** VPD-DC-ICPMS, LPD-ICPMS, gold, silver, platinum.

## REFERENCES

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