IS XPS COMBINED WITH ARGON ION SPUTTERING PERTINENT FOR DEPTH PROFILING MOLYBDENUM IMPLANTED STAINLESS STEEL LAYERS ?

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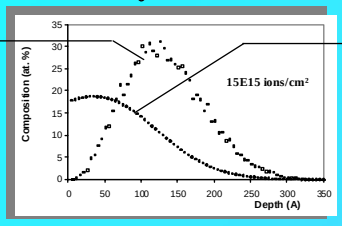
The molybdenum implantation was performed at room temperature on an austenitic (fcc) 316LVM stainless steel (65.5 %Fe, 19.3 %Cr, 13.5 %Ni, 1.7 %Mo) at 49 keV (implanted layer depth = 30 nm and Rp = 12 nm).

Depth profiles obtained by TRIM calculations

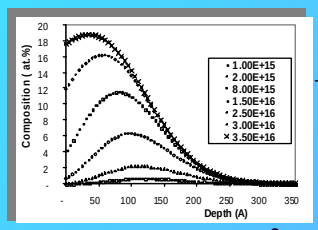
TRIM profile

TRIM calculations do not take into account the sputtering yield



Dynamic TRIM profile

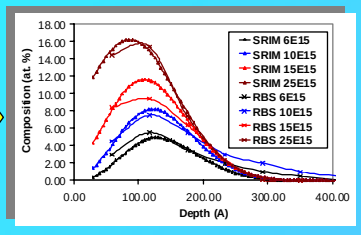
The sputtering yield (5.1 atoms/ion) induces a shift of the profile towards the surface and a Mo concentration decrease



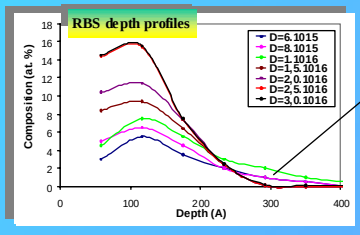
Dynamic TRIM profiles as a function of the doses

Comparison between TRIM and RBS depth profiles

Good agreement between TRIM calculations and RBS analyses within experimental error



RBS depth profiles

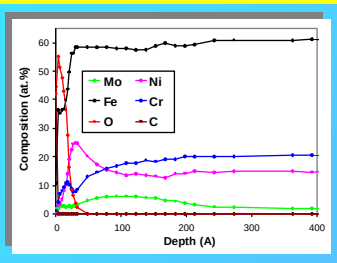


For high implantation current density, implanted layer is thicker

XPS depth profiles obtained after correction of preferential sputtering

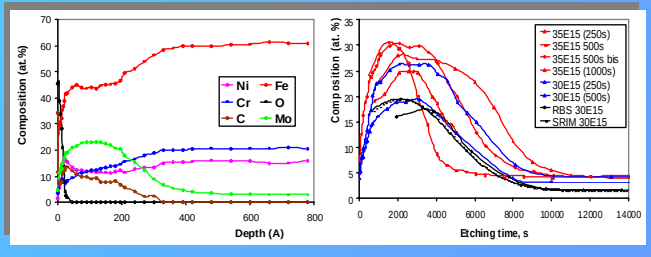
Sputtering yield for argon ion bombardement at 4 keV : Y (Fe) = Y (Cr) = Y (Ni) = 1 and Y (Mo) = 0.56

Low ion implantation doses up to 15. 10^{15} ions/cm ^{2} : expanded austenite + ferrite and no amorphisation



No carbon is detected in implanted layer
Mo depth profile is relatively in good agreement with SRIM and RBS results

High ion implantation doses from to 20. 10^{15} ions/cm² : expanded austenite + ferrite + amorphisation



High carbon concentration is detected in the implanted layer

From 30E15 ions/cm²:

- **Implanted layer is mainly amorphous,**
- **Mo concentration is highly dependent on experimental conditions,**
- **Implanted layer quantification could not be achieved.**

XPS combined with argon ion sputtering

- gives a good estimation of Mo concentration for low implantation doses
- can not quantify Mo in implanted layer for high doses due to sample structure amorphisation