Experimental investigation of adsorption and desorption processes of cryosorbed gases on proposed FCC accelerator walls

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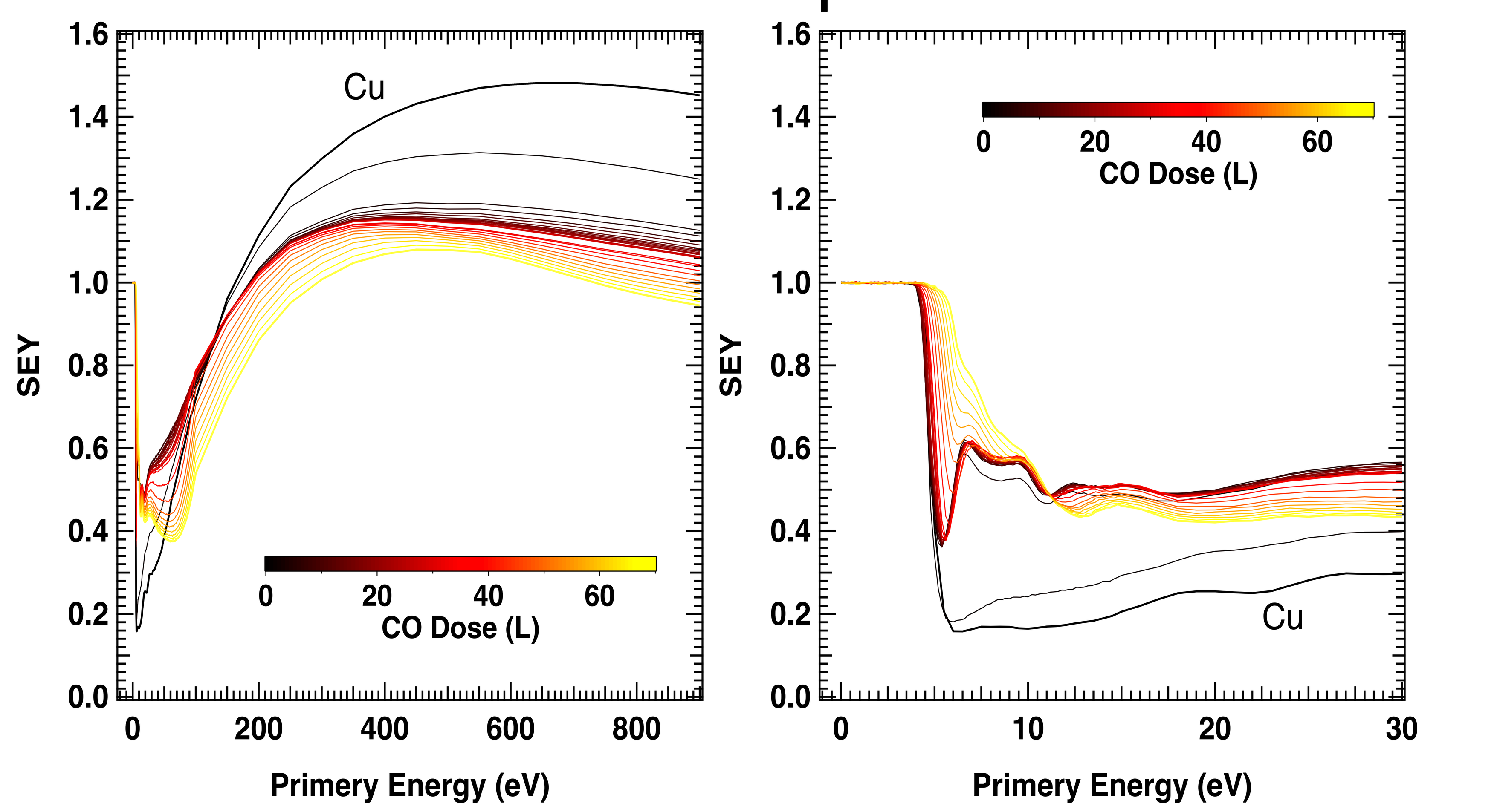
Introduction

In FCC-hh one of the most challenging issue will be the control of all possible instabilities that could occur. Most of the accelerators walls will see the beam while being at low temperatures and their relevant properties will not only depend on the technical materials in use but also on the presence of cryosorbed ice of residual gas condensed on such cold surfaces [1]. Such gas layers may affect vacuum stability and secondary electrons yield even in case of tiny and unavoidable wall temperature fluctuations [2,3].

It is therefore essential to study low temperature adsorption and desorption process versus temperature variation. Studying SEY, it is possible to obtain direct information about its value and on the presence of any gas overlayer. In fact, SEY depends both on the bulk and the surface composition, giving direct information about surface contamination and on different adsorbed gases and molecules. [4]

CO Adsorption



- Strong variation of SEY in Low and High Energy range for low CO dose
- New characteristic features between 5 and 65 eV
- Stable SEY curve until Mono Layer formation
- Low SEY at high CO dose

Conclusions

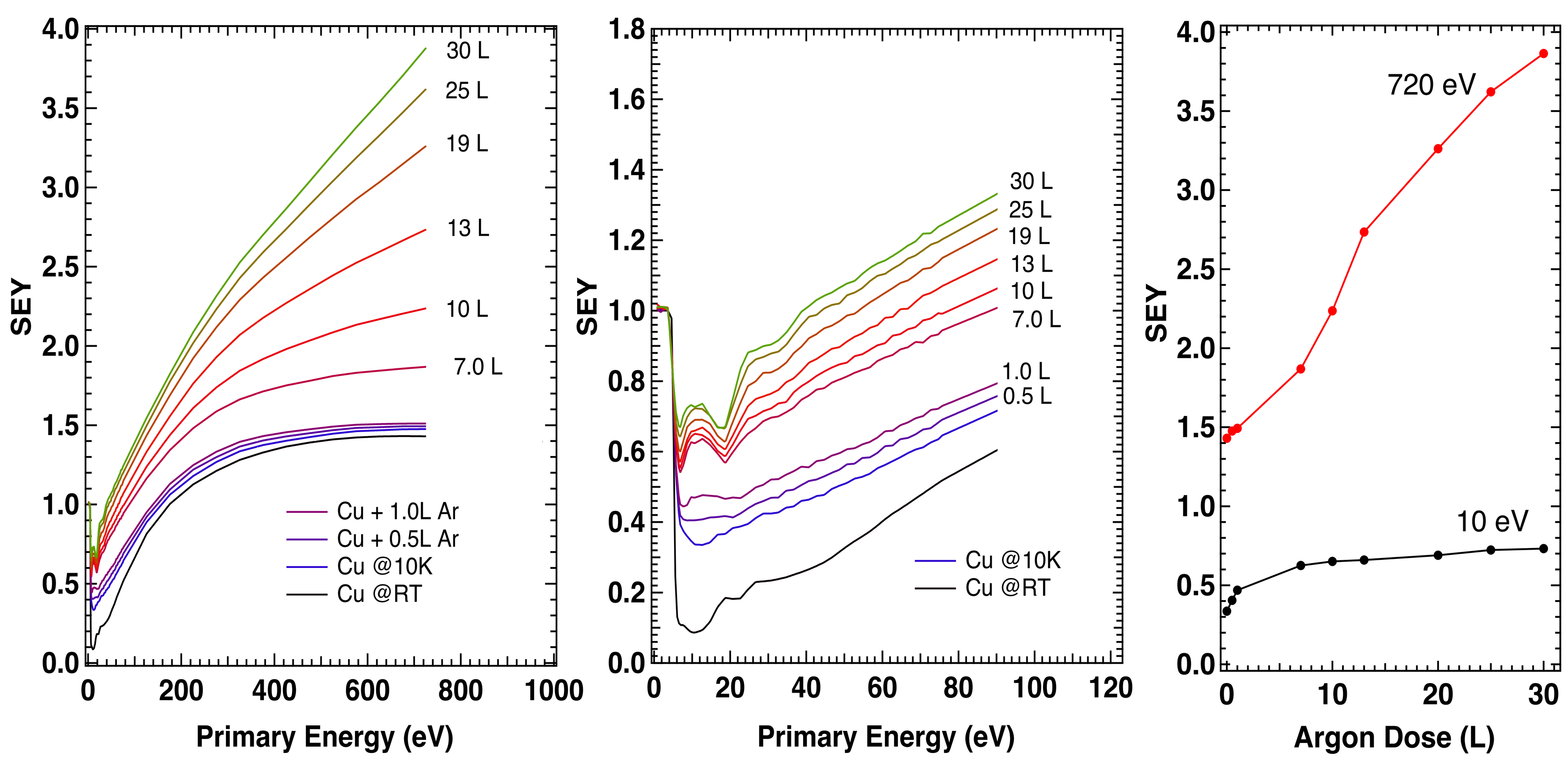
SEY, in the High-Energy range, gives important information about the formation of thick adsorbate layers and about the interaction of the primary beam with them. In the Low Energy range, the presence of characteristic peaks, at different energies, is a clear evidence of the adsorption of one or few gas layers on the substrate. These results show how SEY measurements can be used to follow the adsorption process also at low coverages.

Furthermore, the results obtained for the desorption process show how the measurement of secondary electron emission can give fundamental information about the dynamics of the system during temperature variations.

Experimental

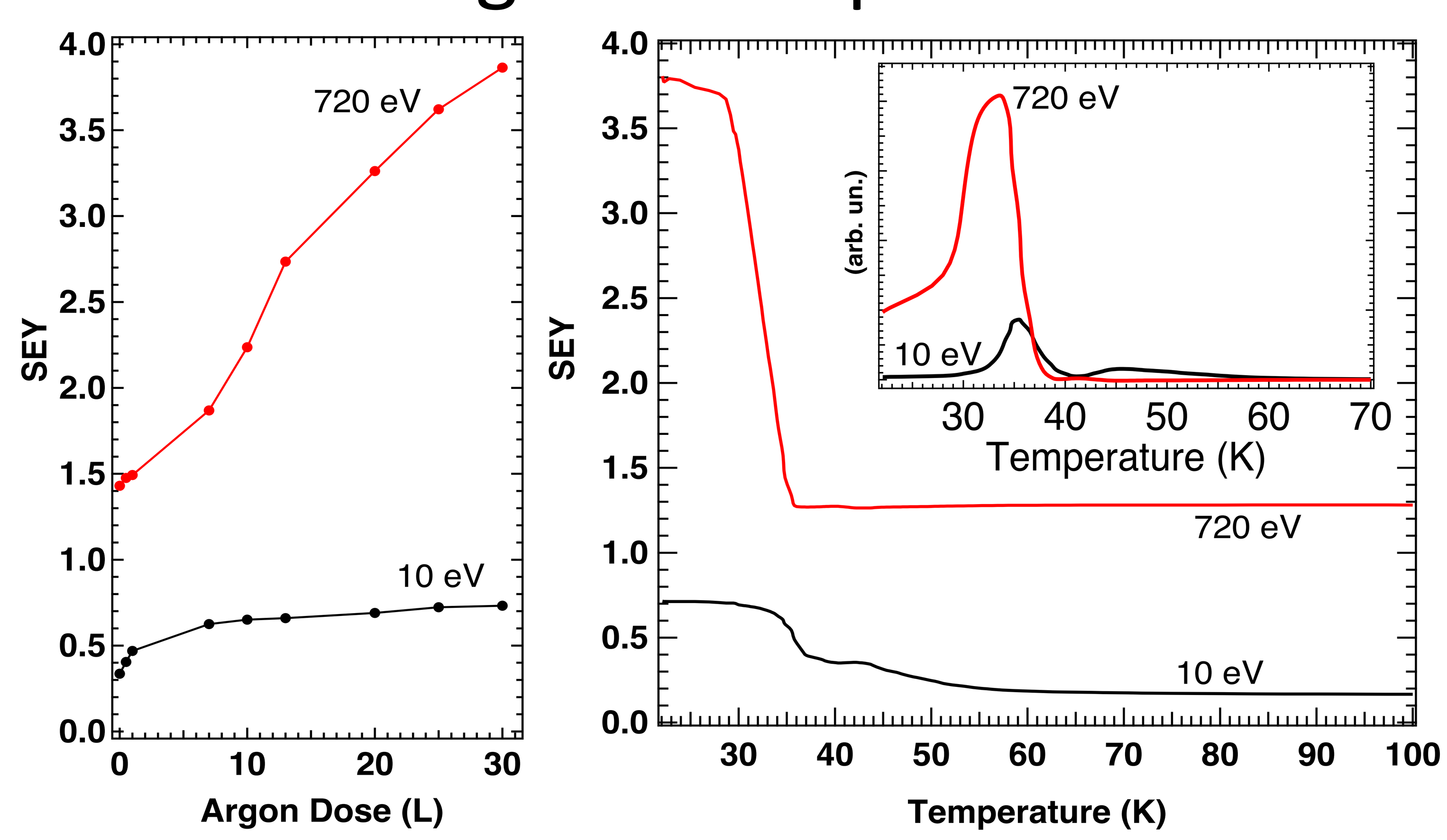
We followed the SEY curve of a clean polycrystalline Cu sample during the exposure to controlled doses of Ar and CO at cryogenic temperature. Ar is chosen as reference being a noble gas poorly interacting with substrate; CO is fundamental to simulating a more realistic residual gas. The clean polycrystalline Cu substrate was chosen since it has a stable SEY during electron bombardment .

Argon Adsorption



- Strong SEY variation in Low-Energy range for low Ar dose
- New feature at 10 eV
- No variation in High Energy range until Mono Layer formation (7 L)
- SEY Increases in the High Energy range after 7 L

Argon Desorption



- Possibility to study the Multi Layer desorption following SEY in high energy range
- Possibility to study the Mono Layer desorption following characteristic feature in the Low Energy range
- Measure the desorption temperature from SEY behaviour

References

1) R. Larciprete, D. R. Grosso, A. Di Trolio, R. Cimino, Applied Surface Science 328, pp. 356-360, 2015
2) R. Cimino, T, Demma, *Int. J. Mod. Phys. A* 29, 1430023, 2014
3) R. Cimino, I. R. Collins, M. A. Furman, M. Pivi, F. Ruggiero, G. Rumolo, F. Zimmermann, PRL 93, pp. 014801, 2004.
4) L. Larciprete, D. R. Grosso, M. Commisso, R. Flamini, R. Cimino, Phys. Rev. Special Topics - Accelerators and Beams 16, pp. 011002, 2013