FIB preparation and TEM characterisation of Si/Sn alloys

Alessandro Benedetti, *Stefan Stefanov, *Stefano Chiussi
CACTI, University of Vigo, *New Materials Group, University of Vigo, Vigo (Spain)

GeSn and SiGeSn alloys represents one of the most attractive group IV semiconductor materials, due to the higher carrier mobility they can achieve[1].

It is therefore of paramount importance to be able to characterise them in terms of morphology, composition, cristallinity and strain distribution with a spatial resolution within the nanometre range. This can be nowadays routinely performed by Trasmission Electron Microscopy (TEM), but the specimen requirements for a successful TEM analysis are stringent: the sample has to be electron transparent, as little amorphised as possible and free from local thickness variations.

Focused Ion Beam (FIB) is a well known technique based on the use of a Ga+ beam, capable of preparing thin TEM-ready lamellas from the region of interest, with a nanometre scale precision. However, in order to minimise the amorphisation of both the sides and the top of the thin lamella the ion currents have to be carefully chosen, depending on the electrical and mechanical characteristics of the analysed material.

GeSn alloys in particular are very sensitive to the ion beam, due to the instability of the cubic structure of α-Sn and the low thermodynamic solubility of Sn in Ge (<1%)[2]

In this work, we briefly summarise the theoretical and practical aspects of the tecnique, discussing the main problems encountered and any possible solution. Various experimental results from GeSn specimens are also presented, proving that the FIB technique can not only provide suitable samples for High Resolution TEM analysis (Fig. 1 left) but also yield valuable information on the Sn distribution (Fig. 1 right).

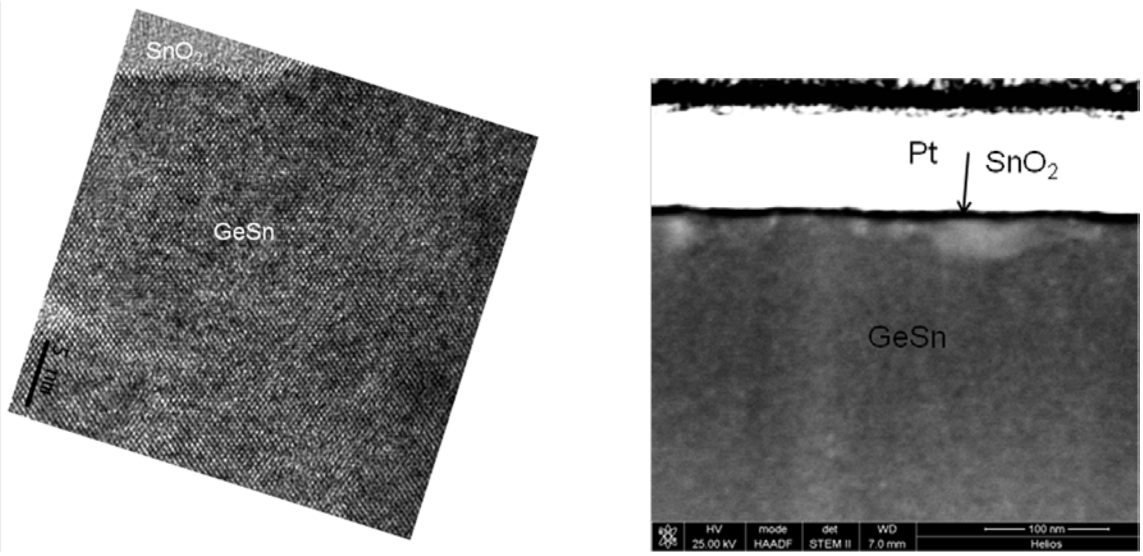

Fig. 1 HREM image of a GeSn sample, showing good crystallinity and little amorphisation (left); FIB-STEM image of a similar sample, with Sn clusters clearly visible near the GeSn/SnO2 interface (right).

References

2 G. Grzybowski et al., App. Physics Letters **99**, 171910 (2011).
1 D.W. Jenkins et al., Phys. Rev. B **36**, 7994–8000 (1987).