

Bringing 2D material integration from lab to fab

Cedric Huyghebaert

Tom Schram, Steven Brems, Daniele Chiappe, Inge Asselberghs, Iuliana Radu

imec, Kapeldreef 75, 3001 Leuven, Belgium

cedric.huyghebaert@imec.be

Recently, a broad family of 2D materials based applications has been demonstrated in different application fields linked to the semiconductor world[1]. These promising results have received a lot of attention, but none of them has resulted yet in a 2D material technology embraced by the semiconductor industry. imec has the ambition to step forward towards the industrial adoption of 2D materials.

This talk will outline the research to push the state of the art by developing semiconductor pilot-line compatible processes in 2D materials integration on 300mm wafers in imec's pilot line.

Imec is exploring integration schemes for Scaled CMOS, TFET, interconnect and silicon photonics, whose main focus is to provide an answer to the question of whether the family of 2D materials could really hold the promises for a successful use in semiconductor industry and as an extension in microelectronics in general.

This is being accomplished with a strategy encompassing two main aspects of research: (1)to evaluate novel device concepts based on the fundamental properties of 2D materials (2) to work towards industrial compatible solutions for 2D material integration in a semiconductor environment.

In the presentation we will touch some of the key learning elements we encountered during the development of these pilot line compatible integration steps. We will also focus on the steps that are needed to bring 2D materials from the lab to the fab. This encompasses the development of fully automated CMOS compatible transfer, encapsulation and contact processes to 2D materials. We will discuss the missing links and evaluate the 'state of the art' of the steps which should result in 2D materials being accepted as standard materials in the portfolio of semiconductor foundries such as Si, SiGe, Ge, SiO₂, Al, Cu...

References

- [1] A.C.Ferrari et al., Nanoscale 7(11), september 2014

Figures 1



Challenges to bring 2D materials from Lab to Fab