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Graphene Technology: synthesis, characterization and reliability-driven technological device integration

Graphene fascinating properties hold promises for a great technological impact [1]. Nevertheless, to allow for a real exploiting of their extraordinary properties, a complete control of the fabrication steps of graphene-based devices is mandatory. In this contribution we will show an integrated approach for the integration of graphene membranes in state-of-the-art technological processes and for the exploitation of their properties in an applicative framework.

Our approach starts from the careful control of the synthesis parameters of the CVD growth of graphene membranes, as well as of their structural and functional properties. It moves then to the definition of tailored transfer processes leading to the integration of graphene membranes in a wide class of functional substrates (technological surfaces, glass, plastic and polymeric flexible substrates), as well as of their surface functionalization, to provide the control of physical and chemical properties over large area, typically mandatory in the device's fabrication processes. [2-5].

Final step is the definition of the complete set of technological processing steps needed to achieve a full integrability of the membranes within the processes of fabrication of micromachined devices. To this aim, since the integration of graphene hybrid devices in silicon CMOS requires high reliability and yield, the full development is supported by the Design for Reliability approach which will address graphene-based electronic devices to really enter the market in the near future, with the maturity level requested by IC technology. More in detail, this is achieved through three main blocks: 1) definition of the requirements for large-scale graphene integration; 2) identification of critical graphene processes for the integration and their optimization; 3) identification of measurement methodologies, standards, data and models for the development of a reliable fabrication process, an accurate process control and the optimization of the processes.

References

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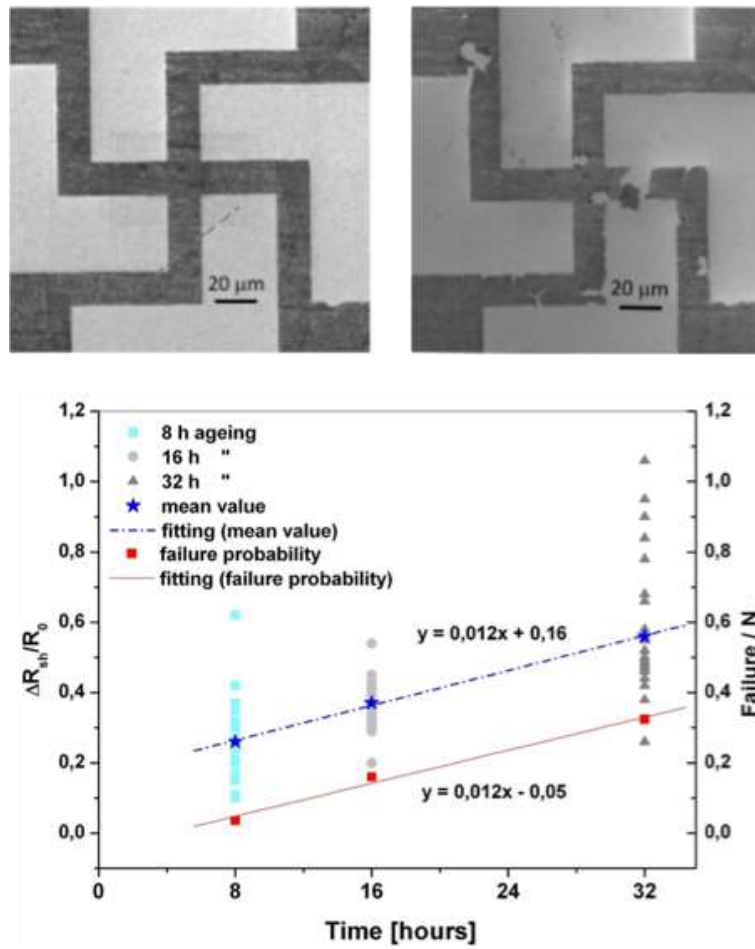[5] S. Drieschner et al. 2D Mater. 3 (2016) 045013

Figures

Figure 1: Reliability-driven graphene integration in Si Technology