Réunions scientifiques

Séminaires

Séminaire SOLEIL

Molecular Beam Passivation of Ge and III-V semiconductors for advanced CMOS

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Future improvements in MOSFETs performances will require high mobility (high-μ) semiconductor channels. The integration of novel materials with higher carrier mobility, to increase drive current capability, is a real challenge to overcome silicon-based CMOS. A solution is to use a germanium-based channel for pMOS combined with a III-V-based channel for nMOS. The main issues of such devices consist in obtaining low leakage current, low interface density and high carrier mobility in the channel. Therefore, passivation of the interface between gate oxide and Ge/III-V materials will require innovations to reach high device performances and EOT scaling in agreement with ITRS roadmap expectations.

A 200 mm Riber Molecular Beam Epitaxy (MBE) cluster tool is used in this study. This MBE system is composed of a III-V growth chamber (to grow $In_xGa_yAl_zAs$ layers or Ge), an oxide growth chamber (to grow high-κ dielectrics and metal gates) and a passivation chamber (to degas samples and to investigate chalcogenide passivation). The high flexibility of present experimental setups enables us to perform various interfacial engineering schemes.

In a first part, passivation of germanium [(001)- and (111)-oriented surfaces] will be discussed. Several combinations of high-κ oxides (Al_2O_3, $LaAlO_3$ …) and interfacial passivation layers (GeO_2 and Ge_3N_4) will be presented. Physical (XPS, TEM, RHEED …) and electrical (I-V, C-V, D_{IT}, κ-value …) properties of these stacks have shown that a well-controlled *in-situ* GeO_x thin layer could provide an efficient passivation of the Ge(001) interface with a very low D_{IT} value and a thermodynamically stable structure.

Then, in a second part, passivation of different III-V materials, such as GaAs(001) - used as reference - and lattice matched $In_{0.53}Ga_{0.47}As$/InP(001) heterostructures, will be considered. Interest in $In_{0.53}Ga_{0.47}As$ as material of choice for nMOS devices is mainly due to its attractive properties, including its high electron mobility (12×10^3 cm^2 $V^{-1}s^{-1}$) and its small optical band gap (~0.74 eV). A comparative physical and electrical study has been led on high-κ oxides/IPL/III-V MOS structures to investigate the impact of various passivation techniques: chalcogenide (H_2S, H_2Se) surface treatment and formation of an interfacial *a*-GeO_X layer.

Formalités d'entrée *: accès libre dans l'amphi du Pavillon d'Accueil. Si la manifestation a lieu dans le Grand Amphi Soleil du Bâtiment Central, merci de vous munir d'une pièce d'identité (à échanger à l'accueil contre un badge d'accès).*

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