Bernard Pelissier, J Material Sci Eng 2019, Volume 8
DOI: 10.4172/2169-0022-C6-139

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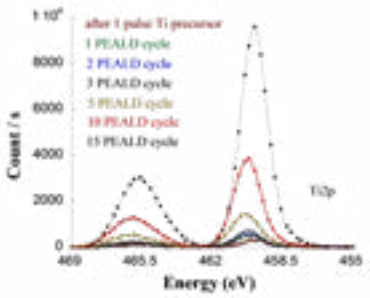
Quasi *in situ* XPS characterization applied to PEALD selective deposition of TiO_2 the IMPACT 300mm project and platform: Merging academic research and industrial applications in microelectronic

Selective deposition (ASD for Area Selective Deposition) processes are currently a very active topic of study in the microelectronic's field. Indeed, this type of growth (bottom-up approach) allows to avoid problems of overlays or CD's variability and mostly to lower costs compared to the classic top-down approaches requiring very complex developments when the dimensions are reduced: multipatterning, or Extreme UV. In this context a selective deposition process of TiO_2 on TiN versus Si has been developed at lab [1]. This type of ASD deposition is based on alternating cycles of PEALD (Plasma Ehanced Atomic Layer Deposition) and phases of surface etching / passivation. In this scheme, these phases of passivation can avoid growth on intended areas for a certain number of cycles ALD. In order to understand and control the key steps in these processes during these successive deposit / engraving / passivation cycles, *in-situ* or *quasi in-situ* metrologies are valuable tools. They become mandatory when addressing surfaces presenting strong reactivity to air, as in this case here (TiN and Si). This concept of quasi *in-situ* analysis with mobile vacuum carrier [2] is one of the key facet of the IMPACT project and characterization platform, which has already been validated for many applications (various growth studies, reactive layers in plasma etching, surface functionalization,..) [3, 6]. Thus, after a synthetic description of the platform's concept and setup the presentation will highlight this specific application for process development of PEALD selective deposition of TiO_2 on TiN versus Si. In particular, the study will describe mechanisms involved for these selective growth cycles, and this at the level of the atomic layer, detailing each cycle from the first layers deposited.



For example, thanks to quasi *in-situ* XPS, it will be shown why, after the surface passivation phase, more than 5 cycles PEALD are needed to restart growth of TiO_2 on Si, whereas growth starts at the first cycle on TiN

Recent Publications

1. Selective deposition of Ta_2O_5 by adding plasma etching super-cycles in PEALD steps Vallat, R. Gassilloud, & al. , J. Vac. Sci. technol. A 35 (2017) 01B104
2. XPS analysis with an ultra clean vacuum substrate carrier for Oxydation and AMC preventionB.Pelissier, H.Kambara, & al. , Microelectronic Engineering 85 (2008) 151-155
3. Impact of Oxidation on $Ge_2Sb_2Te_5$ and GeTe Phase-Change Properties E.Gourvest, B.Pelissier, & al. , Journal of The Electrochemical Society, 159 (4) H373-H377 (2012)
4. Control of C content in amorphous GeTe films deposited by PE-MOCVD for PCRAM applications M.Aoukar, P.Szkutnik, & al. , Journal of Physics D: Applied Physics, 48 (26), (2015)
5. Dry efficient cleaning of PMMA residues from graphene with highdensity H_2 and H_2-N_2 plasmas G.Cunges, D.Ferrah, & al. , Journal of Applied Physics 118, 123302 (2015)
6. Wet and Siconi® cleaning sequences for SiGe p-type metal oxide semiconductor channels P.E. Raynal, V. Loup & al. , Microelectronic Engineering, 187-188, (2018), p84-89

Biography

After an experience in industrial R&D, Bernard Pelissier integrated CNRS (French National Center for Scientific Research) in 1994. His research activities are mainly focused on material science and surface characterisation. He first worked on massive crystalline growth and MOCVD deposition and then integrated LTM (Laboratoire des Technologies de la Microélectronique) in 2001 as XPS surface characterisation manager. His research interest focused on materials fundamentals studies for process development and contamination studies in clean room. He has been involved in several European collaborative projects in surface characterisation. Since 2005 he is interested in *quasi insitu* physico-chemical characterisation using vacuum transfer. He actually manages the IMPACT Equipex project "A 300mm *quasi insitu* advanced characterisation platform combining pARXPS, Raman and ellipsometry using vacuum transfer", dedicated to studies at the frontier between process development studies and upfront research.

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