Université Lille Nord de France

Titre : Acoustic characterization of the wetting of high aspect ratio structures and of their induced mechanical deformation. Application to wet treatment in microelectronic industry for CMOS image sensor of flash memories.

Financement prévu : CIFRE (STMicroelectronics)
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Descriptif :

For the development of advanced technologies such as CMOS Image Sensors or Flash memories, wet process efficiency becomes more and more challenging because of the increasing aspect ratio of the structures (30 / 40 in deep trenches), with nominal dimensions decreasing down to 50nm for contacts and vias. Indeed, wet process efficiency, as well as defectivity (pattern collapse) resulting from these processes are strongly correlated to liquid wetting / non wetting conditions in the structures to be cleaned.

The wetting properties of the aqueous solutions used for these processes have to be characterized, as regard with the structures nominal dimensions (from 50nm for Contacts Holes up to 10µm for "Thru Silicon Vias" (TSV) used in 3D Hybrid bonding approaches), structure geometry (holes or trenches arrays), material surface energy before / after wet process (hydrophobic and hydrophilic surfaces), liquid surface tension and viscosity, dynamic aspects of the wet clean process (liquid flow, wafer rotation speed, …).

This work will be performed at IEMN laboratory, where an original acoustic method has been developed. The wetting of a droplet on microstructured surfaces can be characterized by the study of the reflection of a high frequency (1 GHz) longitudinal acoustic wave generated thanks to thin film piezoelectric transducers fabricated on silicon (backside).

A first work was performed with IEMN (PhD C.Virgilio, 2013-2016, STMicroelectronics / Regional grant), in order to optimize the acoustic method for the nanometer scale. The fabrication of piezoelectric transducers has been optimized in order to reach higher acoustic frequencies (5-6 GHz). The application to liquid wetting (static mode) has been demonstrated thanks to model structures (trenches and holes arrays), with various nominal dimensions and aspect ratios, as well as real Deep Trenches structures.

In this second work, we will deal with a systematic characterization of holes and trenches structures at challenging scales (fabrication based on e-beam use) in order to validate the rules governing structures wetting depending on liquids properties. Fluids Dynamic, as well as fluid viscosity (from aqueous solutions to resists) will be taken into account and optimizations will be proposed for cleaning process efficiency. The possibility to develop an experimental model simulating industrial liquid dispense will be investigated. Moreover, thanks to this method, drying dynamics will also be studied.

Collaborations : STMicroelectronics ; groupe BioMEMS IEMN

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