Experimental Report

Proposal: **DIR-130** **Council:** 4/2014

Title: Characterisation of Interfaces with delamination problems within the framework of the IRT nanoelectronics

This proposal is a new proposal

Researh Area:

Main proposer: **IMBERT GREGORY**

Experimental Team: IMBERT GREGORY
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Samples: Si
SiOCH
SiN

Instrument	Req. Days	All. Days	From	To
D17	1	1	16/11/2014	17/11/2014

Abstract:

Report on the Director's Discretion Time experiment DIR-130

Title: Characterisation of interfaces with delamination problems within the framework of the irt nanoelectronics

Context: IRT NanoElec feasibility tests

Main proposer: Gregory IMBERT – ST Microelectronics

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In the framework of the IRT NanoElec and after the success of previous experiments on the study of delamination at the a-C/SiO2 interface performed in collaboration with STM, this study has been extended to other type of interfaces which are very relevant in the ICs manufacturing and that suffer also from delamination problems. The main objective of the experiment DIR-130 was to start the feasibility study with the interfaces between SiC, SiN, and SiCN, with low-k and ULK materials (porous or not). Determining the profile of hydrogen concentration in these interfaces and the layers involved, and its correlation with the parameters used for their deposition is expected to help in the improvement of the adhesion characteristics of this type of structures.

Eight samples with interfaces between SiC_xN_{1-x} and different low-k and ULK materials were scheduled for measurements:

Slot 1: SiC (800A) / ULK1 (2100A)

Slot 2: SiC (800A) / ULK1 (2100A)

Slot 3 : SiCN (350A)/ ULK 1 (2300A)

Slot 6: SiCN (350A)/ ULK 2 (2000A)

Slot 8 : SiCN (350A)/ ULK 3 (2000A)

Slot 10: SiCN (350A)/ ULK 4 (2000A)

Slot 12: SiN (400A)/ ULK 1 (2300A)

Slot 14: SiCN (350A)/ low k 1 (1800A)

Due to the high resolution needed for some samples, only three samples (underlined) were measured during the experiment DIR-130. Therefore, five more samples are missing and one more day will is needed to finish the measurements on the full set of samples.

Figure 1 shows a representative experimental neutron reflectivity curve measured from the sample Slot 14, having a Si substrate 300 mm-thick, on top of which a SiCN layer, 350A-thick and subsequently a low-k SiCOH layer, 1800A-thick have been deposited. The inset shows a detail of the oscillations in the q-range 0.01-0.06 A^{-1}.

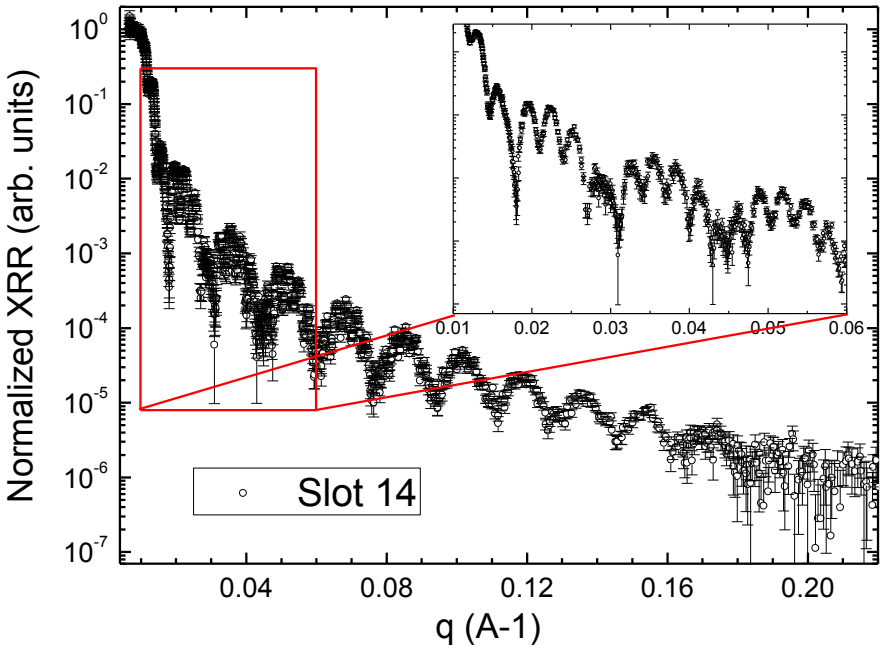

Figure 1 : Experimental neutron reflectivity from sample Slot 14, corresponding to an interface SiCN (~350A)/ low-k 1 ~1800A. The inset shows a detail of the oscillations in the q-range 0.01-0.06 A^{-1}.

Preliminary fitting of the experimental data suggests there is hydrogen inside the underneath SiCN layer, and that there is an intermediate layer with a very high H-concentration in between the SiCN and the low-k layer. However, in order to have define a clear model that allows a better fitting of the entire set of samples, the remaining samples should be measured and included in the study. Furthermore, complementary X-ray reflectivity measurements should be performed in the full set of samples in order to corroborate the presence of H, and to determine its concentration.