A NON-DESTRUCTIVE TECHNIQUE FOR PHASE COMPOSITION AT SUB-NANOMETER BURIED INTERFACES USING SOFT X-RAY RESONANT REFLECTIVITY

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X-ray resonant reflectivity is a surface-sensitivity and element-specific technique [1] and is suited for the investigation of buried interfacial layers. Element specificity is achieved by tuning the energy of the x-rays to the absorption edge of the element being investigated. Thus, the structural and chemical structure can be depth profiled by varying of incidence angle and the energy in this nondestructive technique. We extend the resonant principle to determine the composition of a phase formed at interfaces of a well-characterized Mo-Si multilayer (ML) system through the use of fine structure features of atomic scattering factors at the absorption edge of constituent elements using Indus I Synchrotron Radiation (SR) source.

Prior to soft x-ray measurements, MLs with number of layer pair 5 were characterized using hard x-ray reflectivity (XRR) at wavelength λ=1.54Å (CuK_α). Si thickness was 47 Å with roughness 5 Å. Mo layer thickness was 24 Å with roughness 6 Å. The best-fit results reveals formation of interlayer S-on-Mo 8 Å and Mo-on-Si 10 Å. Hard XRR was not sensitive to phase composition of the interlayers due to poor refractive index contrast among the phases. For that, we had done soft XRR measurements by tuning photon energy in the vicinity of Si L-edges (L_{II} =12.34 and L_{III}=12.41 nm) as shown in figure 1. The measured data were fitted for three different silicide composition.

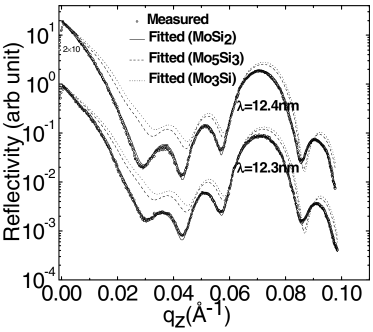

Figure 1 Soft XRR measurements of Mo/Si ML using Indus I SR source

Wavelength (nm)	δ_{Si}	β_{Si}	δ_{Mo}	β_{Mo}	δ_{MoSi2}	β_{MoSi2}
12.3	-0.012 11	0.015 87	0.058 49	0.004 81	0.007 94	0.017 59
12.4	-0.015 47	0.007 43	0.060 49	0.005 11	0.008 03	0.00922

Table1 The best-fit optical constant (δ and β) of soft x-ray reflectivity measurements.

It is clear from Fig. 1, three different silicide phases ($MoSi_2$, Mo_5Si_3 and Mo_3Si) of varying Si content display markedly different optical constants at the edge and that the optical contrast is sufficiently large to enable observation of changes in reflectivity patterns from buried interfaces. The fitted curves for Mo_5Si_3 and Mo_3Si deviate significantly different from the measured data. The best-fit curve reveals formation of $MoSi_2$ phase and optical constant data obtained from this are shown in table 1.

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