Photomodulated reflectance measurement technique for implantation tilt angle monitoring

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implants and to suppress the device parametric variation at high angle halo implants [2]. These requirements are relaxed when quad mode implants are applied with 90Á wafer rotation. For sub-65 nm source-drain extension (SDE) implants beam steering must be controlled to <0.25Á for single step SDE and 1Áfor quad mode SDE step.

Keeping ion beam angle in precise control in production or after maintenance is a key and requires high quality tool monitoring metrology [6]. In our paper we present the excellent tilt angle measurement capabilities of PMR-3000S in-line implantation monitoring tool.

II. EXPERIMENTAL

A. Photo-modulated optical reflectivity

Photo-modulated Optical Reflectivity measurement (PMR) based on the phenomenon of Carrier IlluminationÊ is an excellent non-contact, non-destructive technology for implantation monitoring on as-implanted pre-annealed production wafers with a measurement spot size smaller than 3 Õm.

The working principle of the measurement is based on the known phenomenon that optical excitation of a sample (surface) results in the change of its reflectance. In the case of semiconductor samples, the mechanisms responsible for the reflectance change include the creation of excess carriers and heat gradient due to the excitation. The PMR measurement process focuses mainly to the former thus the optical excitation is provided by an intensity modula2(n)6(t13 Tm0 g0 G[(2(7.1 Tm8E)6(e))-10(h)-5(u)6(s)3(B)Tm0(y)6(n)6( )-351

B. PMR-3000 tool

SEMILAB PMR-3000 shown in Fig. 4. is an ion implantation dose monitoring unit for in-line ion implantation monitoring use preceding the thermal annealing process step. PMR is sensitive in a wide range of implant dose level ($5*10^{10}$: $5{,}5*10^{16}$ ion/cm^2).
The use of a built-in laser light intensity stabilization system results in an enhanced PMR signal repeatability (3ů<0.15%) and stability (3ů<0.45%). (Values are valid for PMR reference

The ion implant tilt angle sensitivity of the PMR tool wa