# Photomodulated Reflectance Measurement Technique for Implantation Tilt Angle Monitoring

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It was shown that for high current implanters less than 0.5°, while for medium current implanters 0.1° of angle control is required to ensure uniform doping for zero tilt well 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 90° wafer rotation. For sub-65 nm source-drain extension (SDE) implants beam steering must be controlled to <0.25° for single step SDE and 1° for quad mode SDE steps.
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 the PMR-3000S in-line implantation monitoring tool.

## II. Experimental

A.

B. PMR-3000 tool

The 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 steps. The PMR tool is sensitive in a wide range of implant dose level ($5x10^{10}$ – $5.5x10^{16}$ $ions/cm^2$).
The use of a built-in laser light intensity stabilization system results in an enhanced PMR signal repeatability of 3 1<0.15% and stability of 31<0.45%. The PMR signal, being a nonlinear function of the physical parameters, shows varying sensitivity at different ranges of those parameters. Thus, a reference sample is required to characterize the performance of the tool. The above values are valid for bare silicon wafers with thermally grown oxide layer of min. 100 nm thickness as reference samples.
Under the foregoing, the sensitivity should be given for every measurement parameter type (e.g. separately for the dose/tilt/energy etc. measurements). This is done by