ADVALAB

Advanced Characterisation Laboratory for New Generation of Semiconductor Structures

http://www.ite.waw.pl

ADVALAB is a research laboratory whose efforts are concentrated on developing new measurement methods and comprehensive characterization of new generations of semiconductor structures. By the structures of new generations we mean the semiconductor structures based on materials, technological processes or design concepts other than those used in the classic silicon technology. Specifically, we have had experience in characterization of MOS structures with high-k dielectrics of low EOT values, and wide bandgap semiconductors (i.e. SiC).

The activities of ADVALAB consist in elaboration of the theoretical background of measurement methods (physical models), implementation of the new measurement procedures, intro-duction of the new measurement equipment, and routine characterization of the batches of structures. In 2006, semiconductor structures made by various research groups worldwide (among others from USA, Japan, Germany, Great Britain, France and Sweden) were characterized in ADVALAB laboratory.

The laboratory permanently employs highly qualified research staff, including one Associate Professor, Ph.D., D.Sc., two Ph.Ds, 2 Ph.D. students, one M.Sc. and technicians. We also collaborate with 6 specialists employed part time.

The research activities of ADVALAB are carried out in three sections: electric, photo-electric and optical methods divisions.

The electric and photo-electric measurements divisions concentrate on determination of the physical properties of MOS and other semiconductor structures.

The main procedures include standard C(V) and spectral photoelectric C(V) and I(V) characteristics in the wavelength range of 200-600 nm. The WSBF - Multitasking System for Photo-electric Investigations allows for extremely accurate determination of the effective contact potential difference ϕ_{MS} in MOS devices, by the original method developed by ADVALAB, and enables reliable current measurements at the level of ten femtoamperes, i.e. 10-14 A.

The I(V) in UV light can be measured by the Innova 90C Frequency-Doubled Ion Laser System. The UV light beam wavelengths of λ = 229, 244, 248.2, 250.8 and 257.2 nm, in power range of 10 - 100 mW are available. The system is particularly useful for determination of the MOS structure electrical parameters distribution over the gate area (see the picture below).

High frequency C-V measurements allow for the characterization of ultra-thin gate dielectric MOS structures, where traditional C-V measurements cannot be used due to large leakage currents. Since we are capable of measuring conductance and capa-citance in frequency domain (SBSNG – the Impedance Spectro-scopy Measurement and Analysis System, including the Agilent 4294A Precision Impedance Meter), we implemented the Nicollian-Goetzberger's well known method of surface state characterization, which is used for examining the energy distributions and dynamic properties of interface traps.

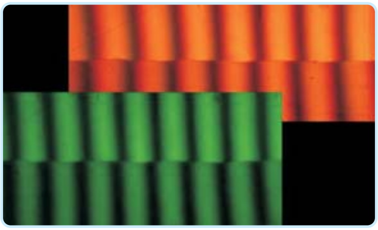
With the admittance spectro-scopy we measure the admittance response of a semiconductor struc-ture to a small electric signal at different bias conditions in the frequency range of 100Hz to 1MHz, and identify the parameters of the semiconductor structure equivalent circuit. The SBSNG system is shown in the picture below.

The scanned light pulse technique (SLPT) methods are used for the precise flat-band voltage measurements. The system consists of the digital oscilloscope Tektronix TDS 5104 and the lock-in amplifier DSP 7265.

The optical properties of the MOS and other semiconductor structures are determined in the ADVALAB optical measurements division.

In particular, the ellipsometric measurements are performed in a wide wavelength range, and the optical properties of thin layer structures are investigated with variable angle spectroscopic ellipsometry VASE method (Spectroscopic ellipsometer VASE from J.A. Woollam, Co, Inc., shown in the photo below).

We evaluate the stress in semiconductor wafers by measuring the curvature of the oxidized wafers and analyzing the Fizeau fringes. The more detailed investigation of spatial distribution of mechanical stresses in semiconductor structures is performed by interferometry and spectroscopic ellipsometry (see the picture below). The Raman microspectroscopy, which has recently been implemented by ADVALAB, will soon be available.



The ADVALAB laboratory is part of the Institute of Electron Technology, Warsaw, Poland.

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