The offer of high tech services
Complex electrical analysis of samples

1. **Nanoelectronic device interface traps and surface properties mapping**
2. **Identification of the electrical equivalent circuit of the nanostructure and interfaces by means of admittance spectroscopy**

Interface traps mapping

Charge transfer phenomena are one of the major factors influencing electrical parameters and reliability of nanoelectronic devices. We measure and analyze the properties of charge traps in nanodevices in terms of trap density and capture cross-section energy distributions, using multiparameter admittance spectroscopy method (MPAS). The MPAS technique consists of graphical analysis of measured nanodevice conductance dispersion signal (G_m/ω), directly related to the density of traps, as a function of surface potential ϕ_S (resulting from gate bias voltage V_G) and of the inverse of the measuring signal angular frequency ω^{-1}. With the MPAS method it is possible to evaluate the trap capture cross-section σ_n directly from the conductance dispersion map, as shown in the Fig. 1.

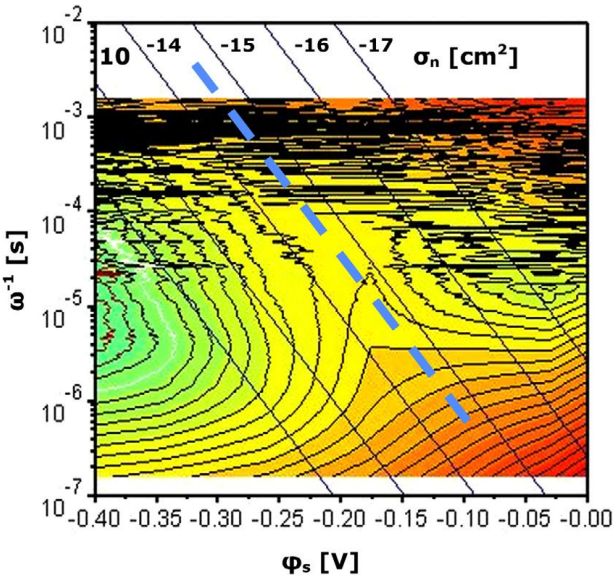

Fig.1 An MPAS map example: $\ln(G_m/\omega) = f(\phi_s, \ln(\omega^{-1}))$, measured in the sample Al-SiO_2-Si(n), t_{OX}=20 nm. The dashed line shows the evaluated capture cross-section value $\sigma_n=2\times10^{-15}$ cm^2 [T.Gutt, H.M. Przewłocki, Microelectronic Eng. 109 (2013) 94-96, http://dx.doi.org/10.1016/j.mee.2013.03.070].

Measurements of electrical characteristics

The laboratory also performs standard and custom measurements of I-V, C-V and G-V characteristics of semiconductor devices with ultimate sensitivity and resolution of 0.1 fA / 0.5 μV, using our Agilent B1500A semiconductor device analyzer connected to the Cascade Summit 12k semi-automatic probe station (Fig. 2). Based on those characteristics, following parameters can be evaluated, at different temperatures T=(-60–200) °C and signal frequency f = (40Hz – 5MHz): semiconductor substrate doping level or profile N_B, flat-band voltage V_{FB} and threshold voltage V_T, density energy distributions of interface traps D_{it} and border traps N_b, and distributions of other trap parameters (time constant τ and capture cross-section σ).

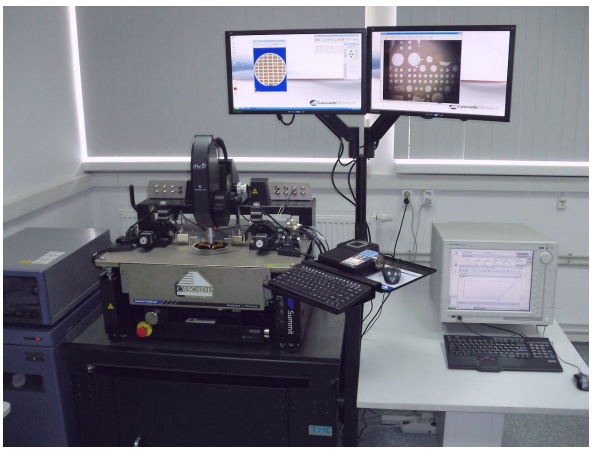

Fig.2 Electrical parameter measurement system equipped with the Agilent B1500 measurement and analysis unit and CASCADE probe station with chuck temperature controller ESPEC ETC200L.

Electrical equivalent circuit identification

It is often necessary in the investigation of nanodevices to identify the electrical equivalent circuit of the nanostructure. Admittance spectroscopy is used in such case in our laboratory, based on Agilent 4294A precision impedance measurements, followed by computer data fitting process.

For electrical measurements customer should agree the sample preparation method.

Contact persons

dr T. Gutt, tgutt@ite.waw.pl