SPECIAL EQUIPMENT

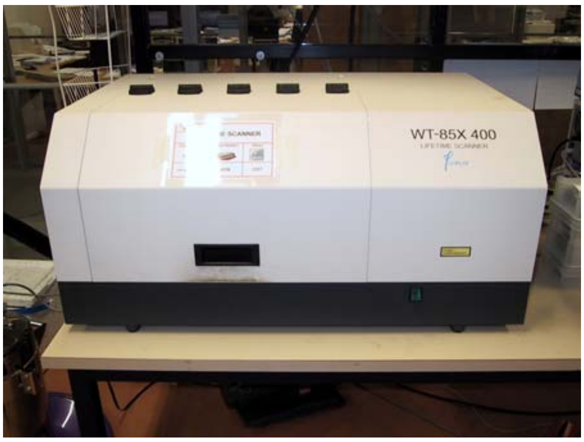
ELECTRON PHYSICS LABORATORY

Scanning Kelvin Probe with Controlled Gas Atmosphere

In cooperation with Semilab Ltd., Hungary, we have constructed a scanning gas Kelvin probe system for the characterization of resistive semiconductor gas sensors operating at high temperatures. Using Kelvin probe technique one can measure without electrical contacts the changes in the surface potential of the gas sensing material caused by a gas atmosphere. The Kelvin probe consists of a vibrating electrode which is capacitively coupled to the sample. The capacitor is charged by the contact potential difference between the probe and sample. This is compensated by the external voltage source. The compensation is detected as a point where the ac current induced by vibrations vanishes. At this point the external voltage reading equals the contact potential difference, which is directly connected to the surface potential. In this way the responses of the gas sensing material to various gases can be examined. The scanning Kelvin probe allows us to get a map of the surface potential changes in the sensor material. The equipment is the most sensitive scanning Kelvin probe in the world. The Kelvin probe is mounted in a special controlled atmosphere test chamber. A computer controlled gas system allows accurately controlled concentrations of gases to be introduced into the chamber.

Figure 1. Scanning Kelvin probe with versatile gas systems

WT-85X 400 Lifetime Scanner



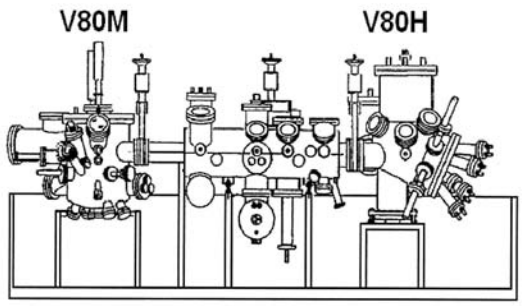
The lifetime scanner is used for monitoring defects and contamination both in the bulk and in the surface region of silicon wafers. The scanner consists of three non-contact and non-destructive measurement techniques: SPV, µPCD, and Kelvin. The µPCD method can be used for the measurement of bulk minority carrier recombination lifetime. The diffusion length of the minority charge carrier can be measured by using the SPV method. Together with light activation, automatic iron concentration mapping is also available.

The Kelvin probe is a measurement technique for characterization of dielectrics (oxide and/or dielectric layer) and the silicon interface. It allows high resolution, whole wafer mapping of oxide charge and surface potential barrier distribution. By applying corona charging, mobile charge in the oxide can also be monitored throughout the wafer. All the techniques can be used to measure wafers and/or wafer fragments of any shape and size up to 200 mm. Full wafer mapping capability is provided with all three techniques. The lifetime scanner is capable of measuring the lifetime in the 80-520 K temperature range with the optional sample cooling and heating system up to 100 mm wafer size. An additional bias-laser can be used to make injection-level dependent lifetime measurements. The KG201 Corona Charge Generator is available for placing accurate negative charge on the wafer.

MOLECULAR BEAM EPITAXY (MBE)

MBE is used to grow epitaxial layers by using thermal molecular beams under ultrahigh vacuum (UHV) conditions. MBE method has many advantages compared to other growth methods. Firstly, a very wide range of material can be grown by MBE. Secondly, the growth temperature of thin films is also lower with MBE compared to other growth methods. In addition, there is very little contamination problems due to the fact that the growth is done under UHV. Thirdly, the interface between different materials can be of high quality and sharp and therefore MBE is an excellent method for fabricating heterostructures. A disadvantage of the MBE method is that the growth rate is quite low.

The Electron Physics Laboratory has a two-chamber MBE. One chamber is used for growing III-V semiconductors, and the other for metals and other semiconductor materials, Our MBE has been used grow e.g. Si/Si$0_{2,}$ superlattices, Sn0_2 gas sensors and magnetic semiconductors(Ga,Mn)As and (Ga,Mn)N.



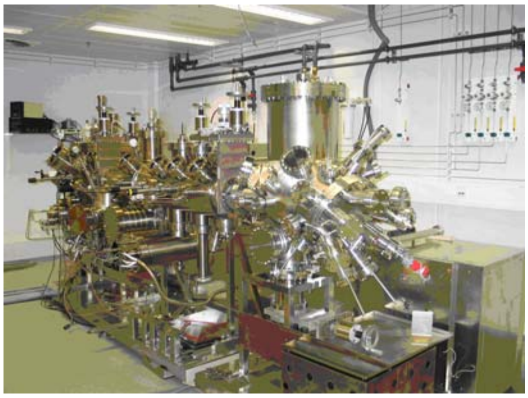


Figure 3: Electron Physics Laboratory's dual MBE system.