inseto	Probe Station Applications – Testing Optoelectronic Devices	
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- SCOPE: How to configure a wafer probe station for optoelectronic applications.

Probe stations can be utilised to test and characterise devices for a wide range of applications. One such application of interest is optoelectronic devices. Optoelectronics (OE) is the study and application of electronic devices that interact with light. This interaction could be the emission of light (LEDs, light bulbs, LASER diodes), channelling of light (fibre-optic cables & waveguides), the detection of light (photodiodes, sensors and photoresistors) or be controlled by the light (optoisolators and phototransistors).

Broadly speaking the interactions listed above can be broken into two groups when thinking about configuring a probe station. In the first group an electronic signal is produced in response to an external optical stimulus, i.e. the device is exposed to light which causes a current to flow or a potential difference to occur. In the second light is emitted from a device due to a current flowing or other process occurring within the device. In both of these cases to fully characterise and test the device, it is important to be able to both probe a device electronically and to be able to measure the optical signal.

Customised Probing Solutions:

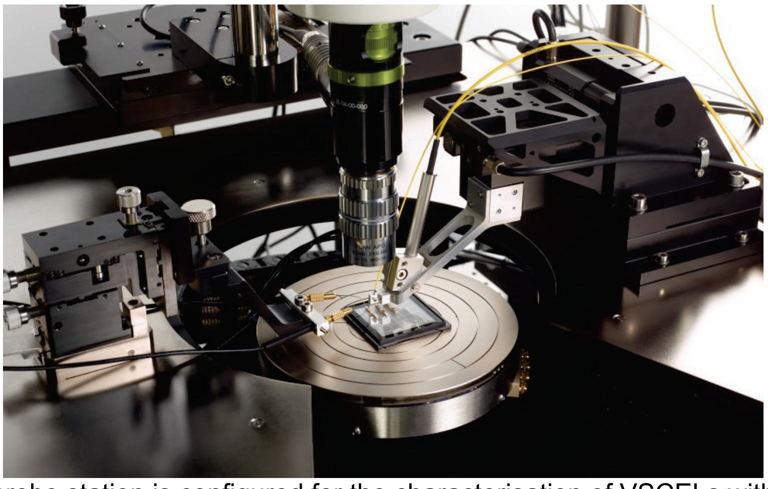
As no two devices are exactly the same any optoelectronic probe station will be highly tailored and customised to the specific application. The probe system for life (PS4L) from SemiProbe allows the integration of standard optical test components with traditional probing accessories to produce a custom test platform specific to any application. The following will outline common features and concepts that must be considered to configure a probe station to work in an optoelectronic setting.

An important question to ask when configuring an optoelectronic probe station is how will the device interact with the light? Will there be a direct optical path from the light source to the device to the optical detector? If so a glass chuck or double sided probing chuck may be required. These will need to be able to hold the device under test (DUT) but also allow the unimpeded transmission of the light.

Optical stimulation, light collection & measurement:

Another consideration for the optical path is how will the light be delivered to the system or if it is produced by the device how will it be collected and measured. One common method is to use an optical fibre to illuminate the device or collect the optical signal. This optical fibre is often mounted on an X, Y, Z and theta (θ) stage allowing the precise control of the fibre. Additionally a goniometer, a device used to precisely measure angles between surfaces, or a non-contact height sensor may be required to allow the full characterisation of the optical path.

An alternate solution to collecting emitted light is to use an integrating sphere. An integrating sphere is a hollow cavity which scatters light evenly over all angles and enables the total power (flux) to be measured without directional inaccuracies. This allows the calculation of the total power from a light source to be captured in a single measurement.



This probe station is configured for the characterisation of VSCELs with both probe arms and an optical fibre to measure the output of each device.

Other considerations:

Other factors to consider for the optical setup of a probe station are what parameters of the light need to be measured; typically this could be, wavelength, phase, intensity, flux or power. Additional filters for polarising, selecting specific wavelengths and modulating intensities may also be required.

Beyond the optical setup required for probe testing optoelectronic devices, the other aspects to consider are common to most probing applications. These include what configuration of manipulators will be required to probe the device? Will these need to be optical, DC, high frequency (HF), high voltage (HV) or even magnetic and how many manipulators will be required. In some cases the wafer chuck will need to provide a bias to the device under test (DUT). The feature sizes and pitch of the devices will also have an impact on the manipulators and probe arms chosen, as will the tolerances required by the application.

Additionally any thermal or environmental requirements must be considered when configuring the probe station. Will the probing be carried out at increased temperatures, if so how will the application of heat be applied without interfering with the optical setup? One common solution is to use a forced hot air system to increase the temperature of the device and to integrate in thermocouples to provide closed-loop temperature feedback. Additionally a localised environmental chamber (LEC) may be required to further control the surrounding environment.

The LEC can be of further use if the probe station is required to probe at negative temperatures. In these circumstances it is important to ensure a stable frost-free environment that is shielded from the external surroundings. Typical thermal ranges incorporated to an optoelectronic probe station are -40–200°C or 25–200°C. This can be extended to include -65–300°C if the application requires.

The final consideration for an optoelectronic probe station is what industry standards such as SEMI or UL that the tool must meet. Commonly incorporated to optoelectronic probe stations are laser safety interlocks to avoid exposing the operator to any intense light whilst the tool is in operation.

In summary an optoelectronic probe station must be highly customised to be able to meet the exact specifications of the optical device. The probe system for life (PS4L) from SemiProbe is a tool which will allow the user to integrate in application specific optical components whilst utilising standard electronic semiconductor probing techniques. These platforms have been deployed in a number of applications such as vertical surface cavity emitting lasers (VSCELs), edge emitting laser diodes (EELDs), optoelectronic MEMs devices, LEDs and optical sensing platforms.

Semi-automatic equipment for 150mm wafer probe testing optoelectronic devices

Semi-automatic probe system for characterising 150mm optoelectronic wafers