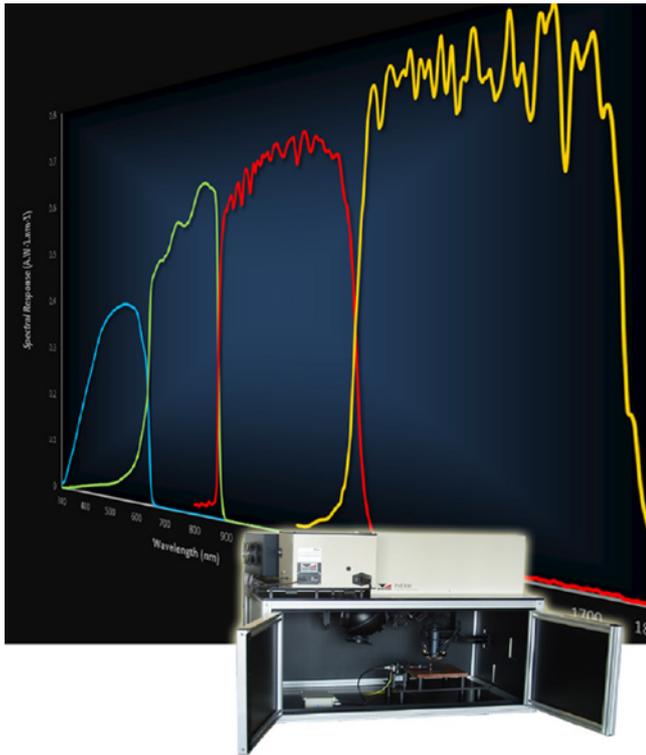


# 4-junction PV device Spectral characterisation



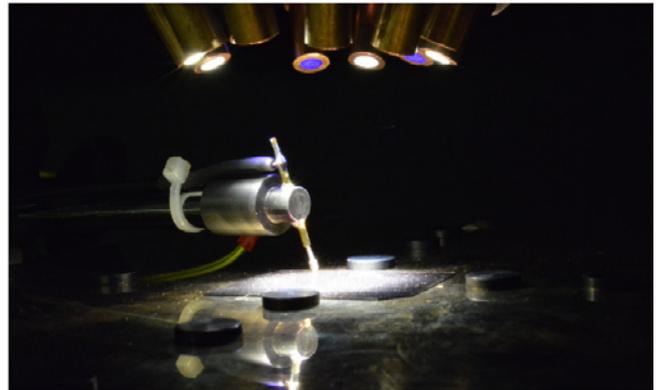
The Bentham PVE300 has proven exceptionally popular in research institutes and industry for the spectral characterisation of PV devices. As PV technologies evolve, so does the capability of the PVE300. Here we introduce the measurement of the spectral response/ EQE and IQE of four junction solar cells.



It is not possible to measure the spectral responsivity/ EQE of the component junctions of a monolithic four junction solar cell separately since they are epitaxially grown on one substrate and interconnected by tunnel diodes.

The spectral response of a junction is measured by putting it into current limitation by applying an appropriate light bias to generate an excess photocurrent in all other junctions. In this manner, the photocurrent generated by the four junction device is defined by the response of the junction under test to the monochromatic probe of the PVE300. Where the junction under test exhibits a low shunt resistance or low reverse breakdown voltage— as is common with low band gap materials such as the germanium bottom cell— complex interactions between junctions can lead to erroneous results.

The correct measurement of four junction PV devices requires the use of optimised light biasing for all junctions and voltage biasing for the bottom junction.



## PVE300 – Accessories required

In addition to a PVE300 system configured for measurement of spectral response over the spectral range 300-1800 nm, the following accessories are required for the evaluation of four junction devices.

### Four junction filters



A set of seven filters are provided to ensure optimal light biasing conditions of all four junctions to be tested.

### Voltage biasing

Voltage biasing is provided by a Keithley 2400 source meter.

### Dual bias light sources

With appropriate filtering, one quartz halogen-based bias light source serves to bias shorter wavelength junctions whilst the other to bias those at longer wavelength.

### 474 Transformer

The 474 transformer allows both accurate measurement of spectral response/ EQE— even under illumination by the two bias sources— and application of a voltage across the device where required.

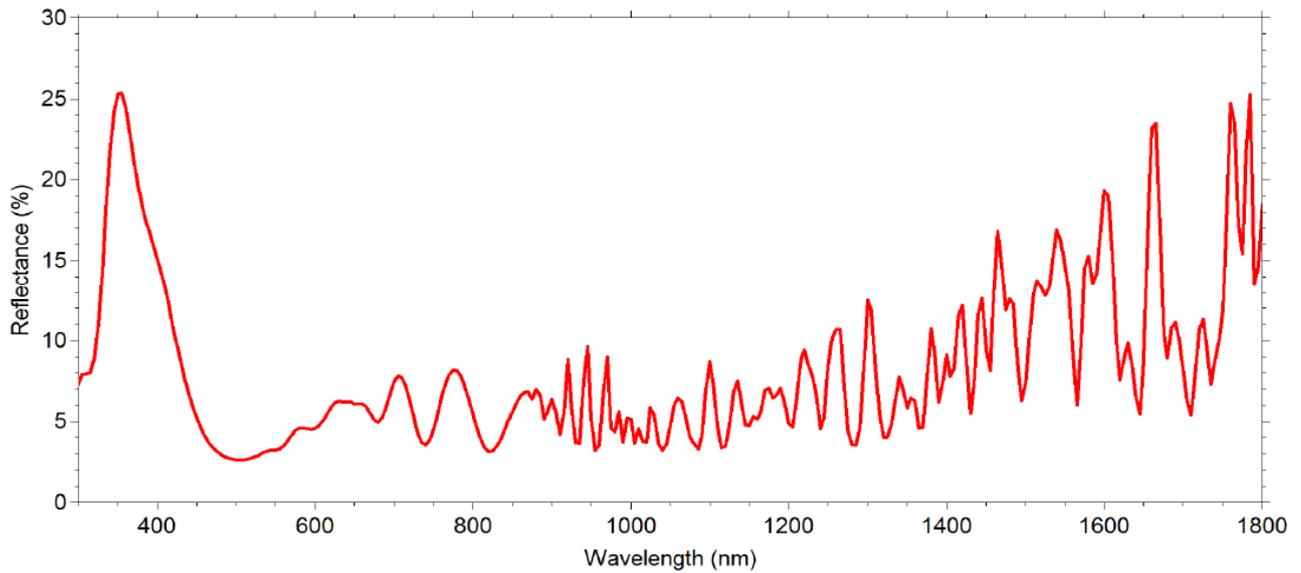


# 4-junction PV device

## Spectral characterisation

### Reflectivity measurement

Having determined the spectral response of all four component junctions, one can directly compute the EQE, and, with the addition of a reflectance measurement- in the PVE300 using the DTR6 integrating sphere accessory, compute the IQE.



### Comparison of EQE and IQE (EQE = bold lines, IQE = pale lines)

