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TM021 – Polariser/analyser accessory WiRE 5

This module details the correct procedure for configuring the inVia Raman microscope for polarised Raman measurements.

inVia can be purchased with optional optics to conduct work in a variety of polarisation states. There are two specific optics, a motorised wave plate that is inserted in the incoming laser beam and a polariser analyser kit placed after the Rayleigh filter. inVia may be supplied with both, one or none of these components.

inVia Raman microscope employs 180º back-scattering geometry, not all polarisation states of crystals may be analysed (those states that require 90º vectors, e.g. x(-,-)y and x(-,-)z cannot be analysed). The z(y,y)z and z(y,x)z may be analysed. The use of a half wave plate in the laser delivery path and the use of the polariser and half wave plate kit further allows x(y,y)x and x(y,z)x states to be analysed.

In this module we consider the polarization state when working in backscatter geometry is z(x,-)z. (light striking the sample along the crystal axis (z-axis) and returning along the same axis, by default the lasers on inVia are already polarised in x)

The motorised ½ wave plate allows the polarisation of the incoming light to be changed.

Inserting the half wave plate rotates the beam polarisation 90 degrees so z(x,-)z to z(y,-)z.

Alternately the sample can be rotated by 90 degrees to achieve a similar result (not identical).

The motorised ½ wave plate can be selected in the advanced measurement options.

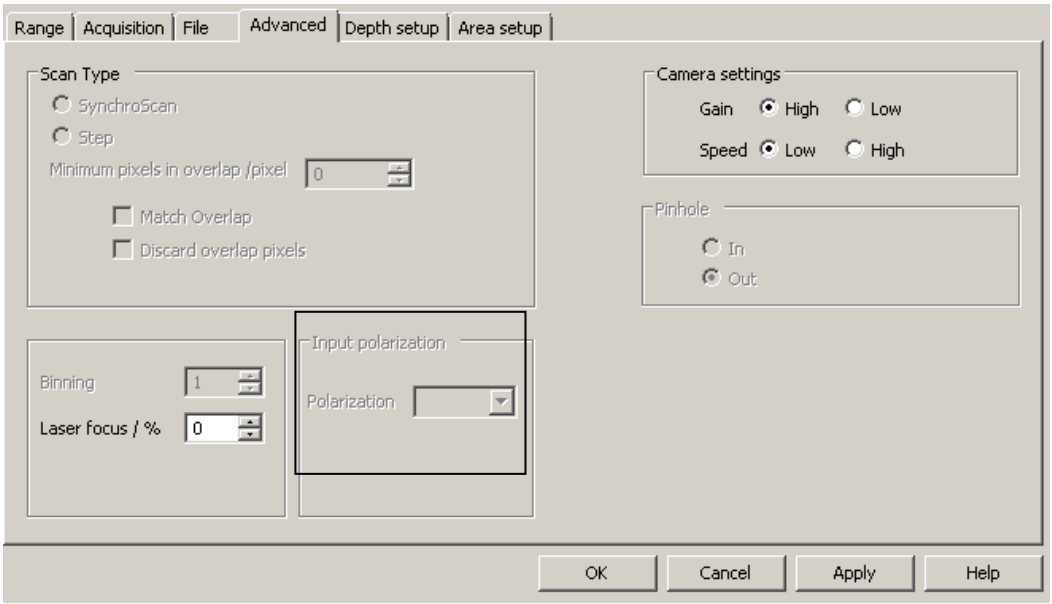

Figure 1. Advanced measurement tab

In order to perform polarised Raman measurements on the detected light, some means of rejecting Raman scattered light that has a polarisation direction parallel and perpendicular to that of the excitation source is required. Renishaw's inVia Raman microscopes can be equipped with a polariser/analyser kit. In order to achieve two orthogonal states, a half wave plate (the analyser) is included in the kit. This ensures polarisation effects from the grating do not contribute between the two states).

Figure 2 indicates the position where the combined polariser/analyser kits are installed for a dual laser instrument with a rotating Rayleigh filter mount.

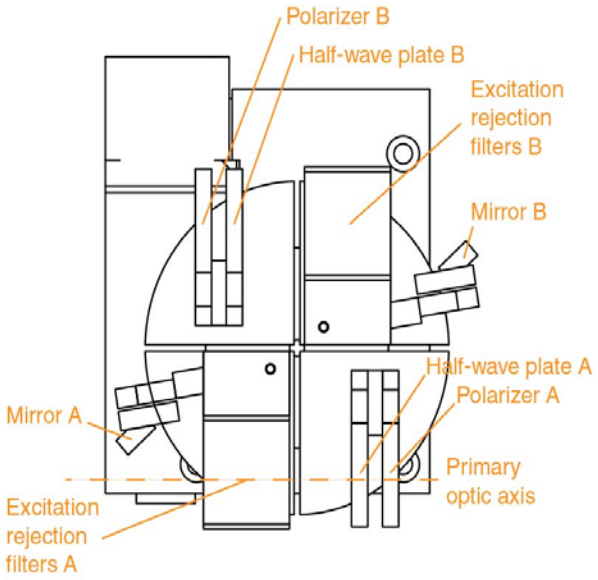

Figure 2. The position where the combined polariser/analyser kits are located.

The polariser/analyser kit allows the detected light to be polarised.

- Putting the **polariser** in the beam will change the polarisation from z(x,-)z to z(x,x)z
- Putting the **polariser and analyser** in the beam will change the polarisation by 90 degrees, hence z(x,-)z will change to z(x,y)z

General Raman measurements do not require the use of polarisation optics. In these instances, both the polariser and half wave plate should be rotated out of the optic beam path. Simply insert the optics into the Raman beam path by rotating them until the detent is felt.

Analysing liquids

The classical example for polarisation measurements is CCl_4. This molecule is tetrahedral and has a spherical polarisability ellipsoid. The polarisation direction of the totally symmetric stretching vibration ('breathing mode') will be identical to the polarisation direction of the laser. Inserting the polariser accessory into the beam path just behind the rejection filter (see Figure 2) should make only a small difference to the intensity of the symmetric stretching band (the polarisers are not fully 100%T). If the analyser (half wave plate) is then inserted in to the beam path (just in front of the polariser accessory) the polarisation direction of the symmetric stretch band is rotated to become perpendicular to the direction of polariser and therefore rejected. The intensity of the symmetric stretching vibration will be reduced to approximately 0.01%. The light will not be completely distinguished due to the laser being not completely polarised. The degree of depolarisation of other, less symmetric, vibrations can be measured.

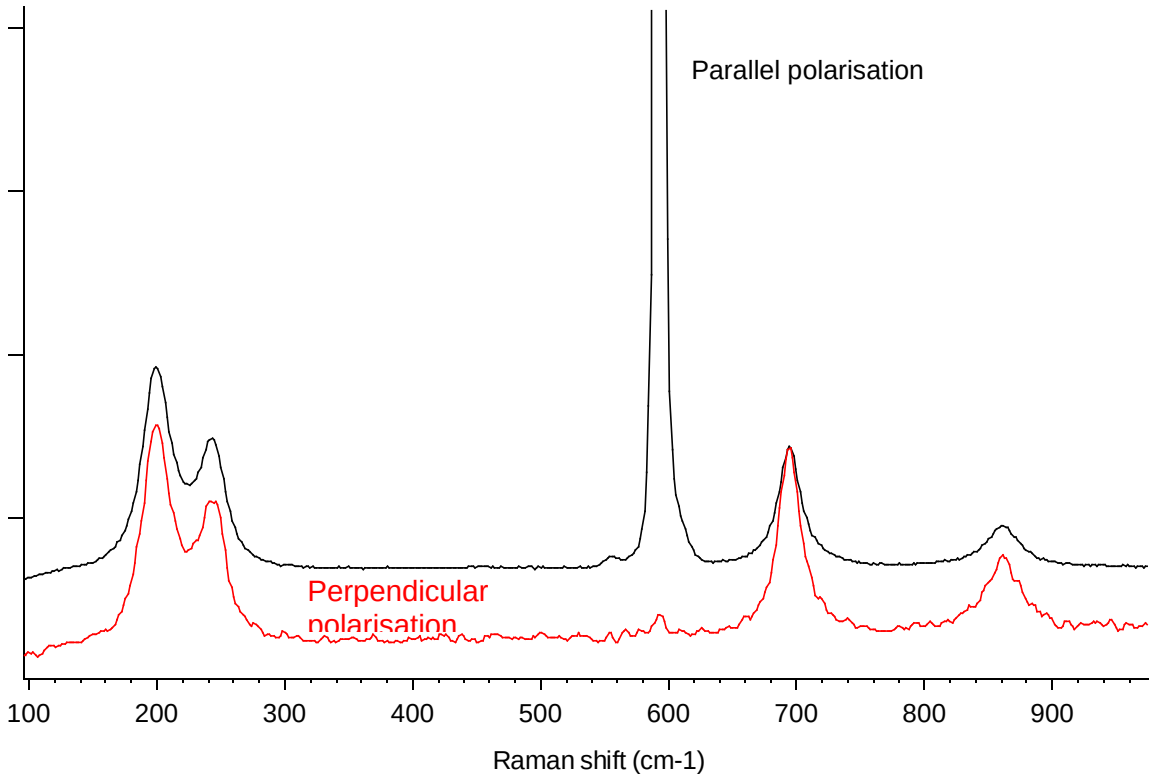

Figure 3. Polarised Raman spectra of CCl_4.