HORIBA Scientific

How to Raman

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How to ...

... measure samples sensitive to laser power

Context

Some samples can be sensitive to the laser power. This is a procedure describing how to optimise the laser power: low enough to not burn the sample, but high enough to get the good quality signal in the shortest time possible.

How to recognise if the laser power is too high?

Sometimes the sample can be damaged but no traces are observed on the surface of the sample. The Raman spectrum is more sensitive to the possible changes.

Run a real time measurement and observe changes in the spectrum with the time:

✓ Are peaks shifting to lower cm^{-1} positions and/or is their peak width increasing?

- The sample is heating too much.

✓ Does a large background appear gradually in the spectrum, or is the Raman peak intensity getting lower even if the laser power is increasing, or does an amorphous carbon spectrum appear?

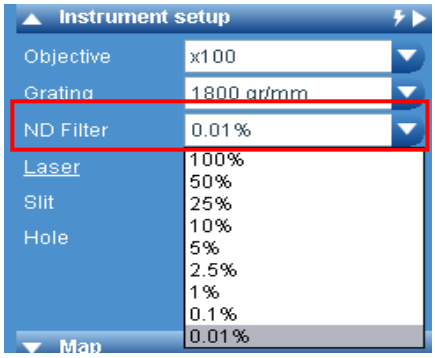
- The sample is getting burned.

✓ Is the spectrum changing drastically?

- The structure of the sample is changing: it could be heat induced crystallisation or phase transition.

How to optimise laser power?

1. Decrease the laser power as low as possible. If you use LabSpec6, use the automatic density filters. Choose 0.01% option.



2. Adjust the acquisition time and do a measurement.
3. Increase the laser power – choose next density filter 0.1%.
4. Adjust the acquisition time and do a measurement.
5. Normalise the spectra and compare the spectrum with the previous one.
6. If no changes in the spectrum are observed increase once again the laser power and continue until you observe some changes. If the spectrum change, stop the measurement and go back to the previous laser power. This is the optimised laser power.

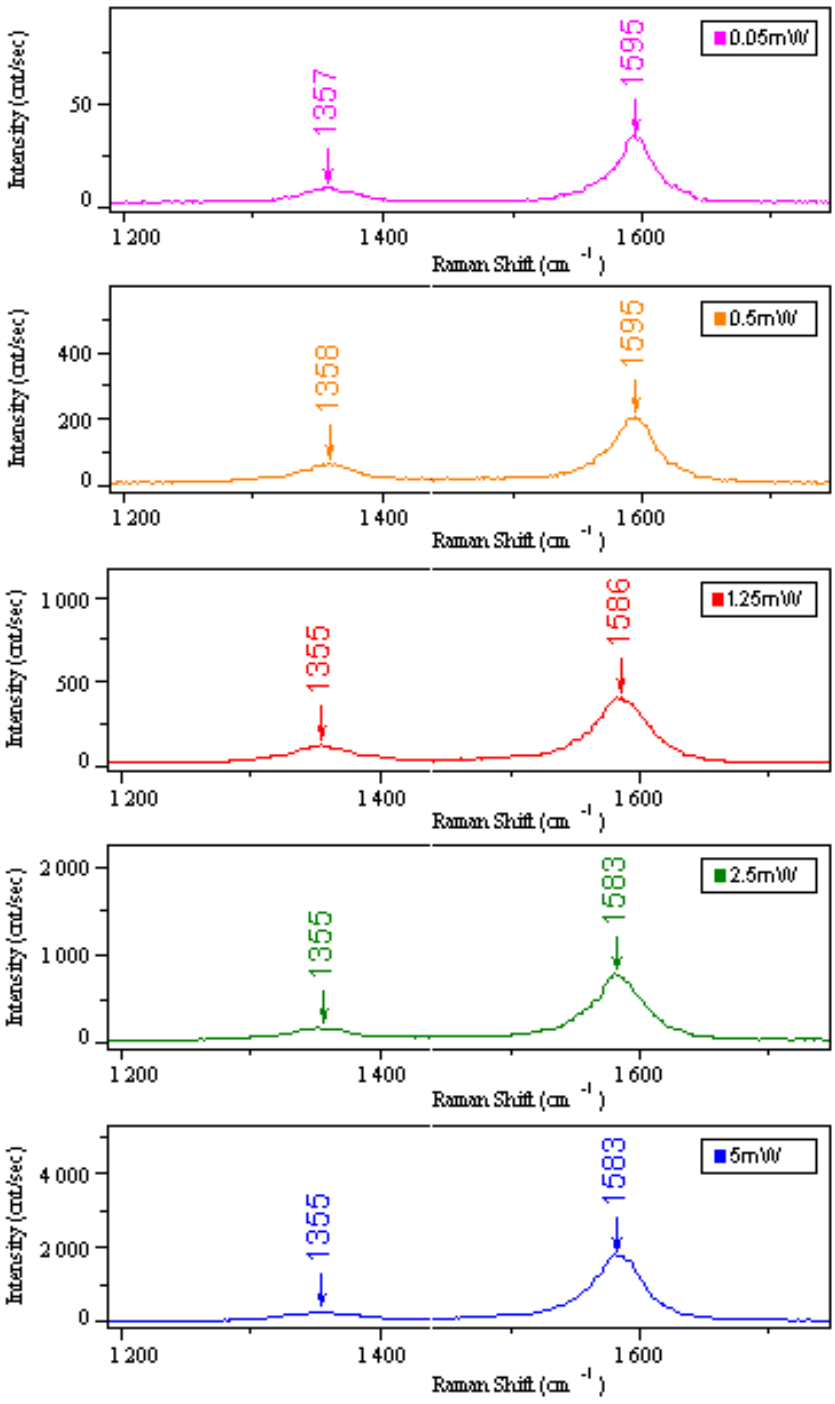
Example

Carbon samples (e.g., CNT, or graphene) are known for their resistance but some of them can be quite sensitive to the temperature induced by the laser beam.

The figure shows the spectra of single-wall carbon nanotubes (SWCNT) that were measured with a 514nm laser with increasing laser power (0.05 mW, 0.5 mW, 1.25 mW, 2.5 mW and 5 mW at the sample).

The two observed peaks shift to lower frequencies with a growing laser power. The G band (approx. 1595cm^{-1}) shifts more than 10 cm^{-1}.

The optimal choice is the highest power which does not introduce any changes: here is the second from the top (orange spectrum) which corresponds to 0.5 mW at the sample.



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