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Configurable High-Throughput Raman Probe

IPS OFFERS A COMPLETE LINE OF CONFIGURABLE RAMAN PROBES FEATURING THE FOLLOWING CHARACTERISTICS

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Innovative Photonics Solutions Configurable High-Throughput Raman Probe

IPS offers a complete line of configurable Raman probes that feature the following characteristics:

- Common probe design for single or dual-wavelength probes.
- High throughput optical design that maximizes Raman collection efficiency.
- Multiple single-wavelength designs (405, 532, 638, 785, 808, 830, and 1064 nm) for interrogating the fingerprint (0-2000 cm^{-1}) Raman band.
- Multiple dual-wavelength designs (680/785, 735/830, 860/1064 nm) for interrogating both fingerprint (0-2000 cm^{-1}) and stretch (2000-4000 cm^{-1}) Raman bands. Dual wavelength excitation sources which can expand the scattered Raman wavenumber range to cover both the fingerprint (0-2000 cm^{-1}) and stretch regions (2000-4000 cm^{-1}) with a single spectrometer [1-3].
- Embedded Teflon standard in shutter for reference measurement.
- Configurable working distance (1.6 to 20 mm).
- Configurable excitation spot size
- Configurable excitation optics for optimizing NA (0.18-0.55) for different excitation fibers.
- Configurable collection optics for optimizing NA (0.18-0.55) for different f# spectrometers.
- Removable collection and excitation fibers for system optimization or repair.
- Configurable Raman filter packs for different cut-on wavenumbers (65 – 200 cm^{-1}).
- Configurable Probe tips for both laboratory and immersion applications

A few details of these configurable options are outlined below.

Configurable Working Distance

Selection of the lens tube optic focal length allows one to tailor the depth of field and the working distance of the probe [Figs. 1, 2].

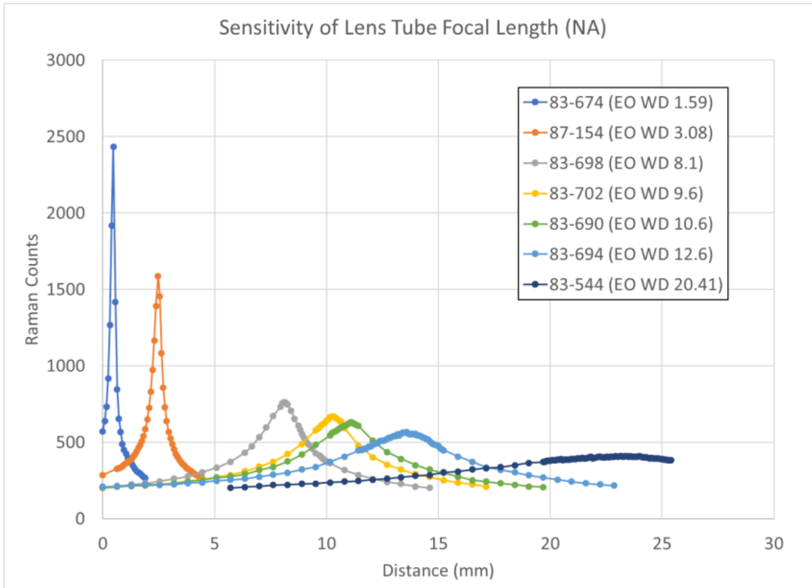

Figure 1 – Sensitivity of relative Raman counts versus probe distance for different lens tube optic focal lengths.

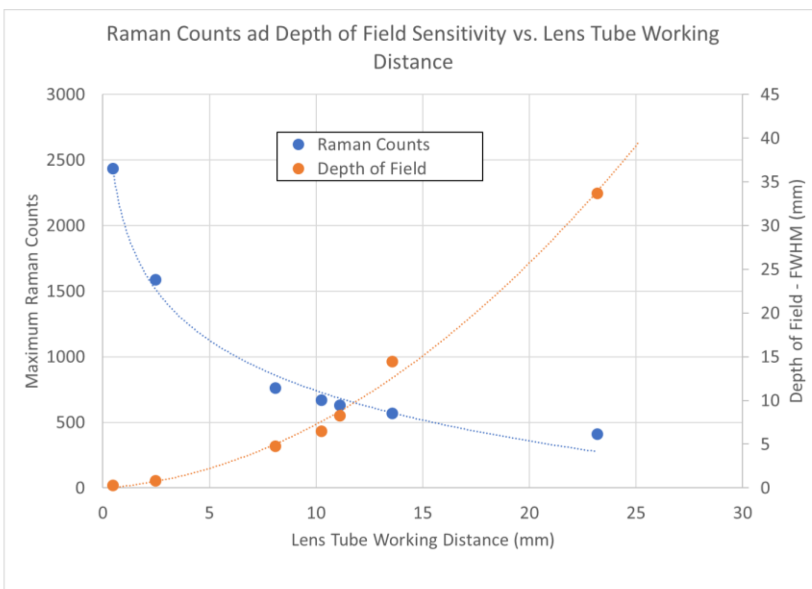

Figure 2 – Sensitivity of maximum Raman counts and depth of field (full width half maximum) versus lens tube working distance.

Configurable Excitation Spot Size

In addition, addition it is also possible to tailor the focused excitation spot size (h2) by individual selection of the laser excitation fiber diameter (h1), the focal length of the excitation collimator (f1) and the focal length of the lens tube optic (f3) as shown below in Figure 3.

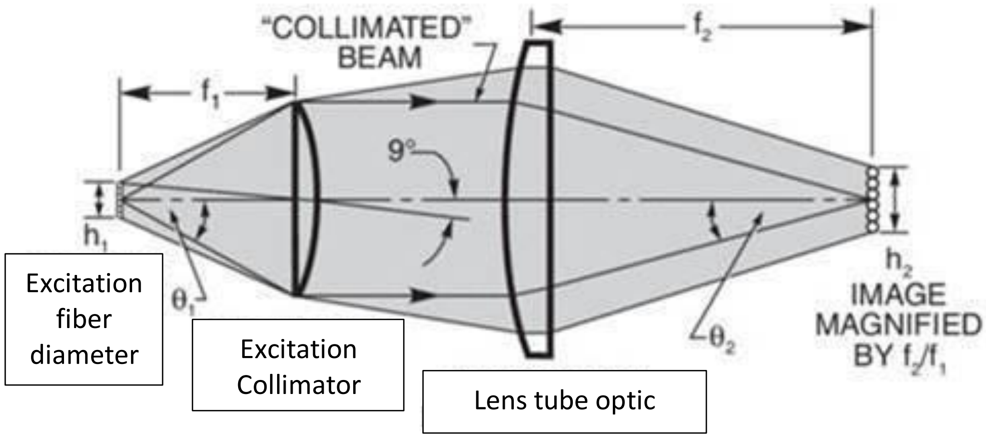

Figure 3 – Magnification of the input spot size by selection of different focal length lens of the input excitation collimator (f1) and the focal length of the lens tube optic (f2). h2 = f2/f1*h1.

As shown in Fig. 3, there are a number of things you can do to change the spot size (h2), which all have pros and cons:

1. Reduction of f2 (lens tube focal length): this will reduce h2, but this will also reduce your depth of field and there may be system constraints in reducing f2 too far.
2. Reduce h1: this will also reduce h2, but you may start limiting the power coupled into the fiber if the laser diode near field emission width is larger than h1.
3. Increase f1 (focal length of the excitation collimator): In general, you want to match the numerical aperture of the excitation collimator to the NA of the source to maximize the power at the sample. Increasing f1 or reducing the NA less than the NA of the excitation fiber will result in less light in the collimated beam and lower power at the sample.

Figure 4 illustrates the excitation spot size sensitivity versus excitation collimator numerical aperture and lens tube focal length for a 105-um-diameter core excitation fiber (h1).

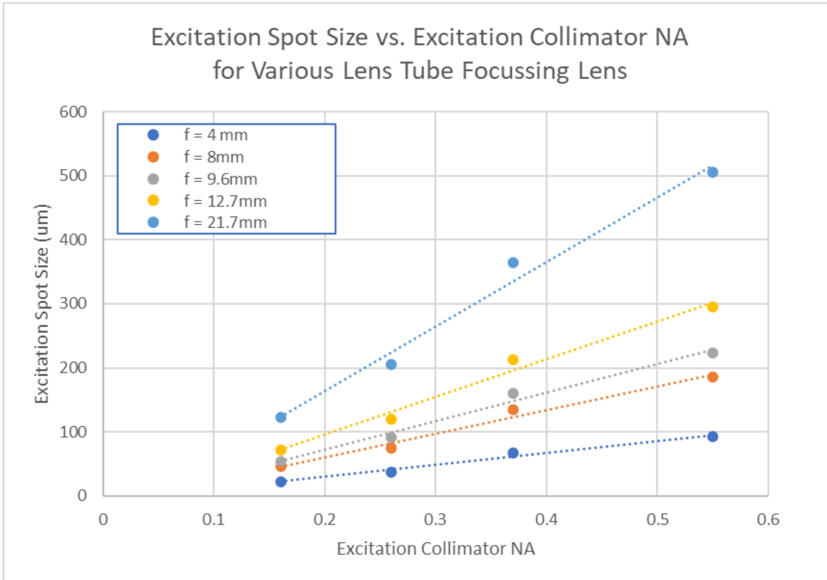

Figure 4 – Excitation spot size vs. excitation collimator NA for various lens tube focusing lens and a 105 um-diameter core excitation fiber.