Endoscopic Raman sensing and imaging with a single multimode fiber

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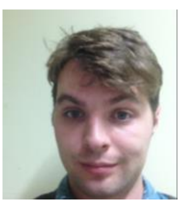
Raman spectroscopy is a label free and non-destructive optical technique used across the life sciences to characterize the chemical composition of an analyte. In recent years, there has been growing research interest to miniaturize Raman devices for endoscopic applications using optical fibers. In doing so, researchers have been hindered by the modal mixing within the fiber, which scrambles the input light into a speckle pattern and large background signal from the fiber. To resolve this, researchers typically utilize fiber bundles with distinct excitation/collection fibers with micro lenses and optical filters fabricated on the distal facet. Although these probes have achieved impressive results, the use of multiple fibers leads to an increase in the overall footprint of the probe.

By applying a wavefront shaping technique and state of the art statistical techniques, we show how a single, hair thin multimode optical fiber to perform Raman imaging in the fingerprint region with sub-cellular spatial resolution. The Raman signal may also be enhanced by coating the tip of fiber with plasmonic, gold nanoislands (SERS). We also discuss how a spatially resolved SERS signal may be collected through the waveguide and how plasmonic optical fibers may be used to detect neurotransmitters at low concentrations.



Short Bio:

Liam Collard received his PhD degree in Chemistry/Mathematics from University of Leicester, UK. He is a researcher at the Italian Institute of Technology, Center for Biomolecular Nanotechnologies, Lecce, Italy.