COMPACT MULTIPHOTON ENDOMICROSCOPE WITH ELECTRICALLY TUNABLE FOCUSING OPTICS

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Multiphoton Microscopy (MPM) is widely applied for tissue imaging, providing deeper imaging depths and higher resolution in scattering tissues than standard microscopy techniques. Based on cellular autofluorescence and second harmonic generation (SHG) from collagen, many details of the tissue morphology can be visualized without any staining with fluorescent markers. Label-free multiphoton imaging allows, for example, to visualize inflammation related changes in the colon in inflammatory bowel disease. The technology is very well suited for endomicroscopy using miniature needle objectives based on gradient index lenses.

Here, we present a compact multiphoton endomicroscope for label-free tissue imaging in small animals. The system consists of a galvanometric laser scanner, a femtosecond-pulsed fiber laser and a gradient index (GRIN) lens objective for endomicroscopy. An electrically tunable lens is implemented to facilitate fast shifting of the focal plane and acquisition of 3D volume stacks in live tissue. The setup is entirely rack-mounted and easily transportable between laboratories and animal facilities. Our endomicroscope can show the tissue morphology of unlabeled mouse colon with single cell resolution and can image tissue in three dimension to a depth of ~100µm based on cellular autofluorescence and second harmonic generation from collagen.