

# USE OF A SINGLE-MODE FIBRE COUPLER FOR SECOND HARMONIC GENERATION MICROSCOPY

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Imaging techniques that use nonlinear optical processes have been demonstrated to have tremendous power in biomedical applications. More recently, second harmonic generation (SHG) has rapidly emerged as a powerful contrast mechanism in nonlinear optical microscopy [1]. SHG can form the basis of a high-resolution nonlinear optical imaging scheme that possesses all of the benefits of multiphoton microscopy. In particular, SHG enables direct imaging of highly polarisable and ordered noncentrosymmetric structures, such as collagen and microtubules [2]. Presently the application of second harmonic generation to imaging biological tissue is limited to observe samples on the bench top with bulk optics. Integration of fibre optics into an imaging system overcomes this physical limitation and may provide the ability to image a remote sample. Bird *et al.* have constructed and characterized fibre-optic two-photon microscopy [3,4]. We have extended it to a second harmonic generation microscope based on a three-port single-mode optical fibre coupler. A fibre coupler is used to replace bulk optics for illumination delivery and second harmonic light collection. The coupler behaves as a low-pass filter that can deliver an ultrashort-pulsed laser beam of as much as 110 mW of power in the wavelength range from 770 to 870 nm as well as collect signal in the visible range. It is found that the low-pass filter has splitting ratio as high as 310 and different modes between signal and excitation arms. In addition, the experimental investigation of polarisation characteristics of the excitation and signal arms shows that coherent SHG signal can be obtained through the conventional fused fibre coupler. The establishment of fibre-optic SHG microscopy indicates the emergence of nonlinear endoscopy that will combine multiphoton excitation and SHG to provide complementary information for *in vivo* applications, which holds promise for basic research and clinical diagnostics.

## REFERENCE

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