

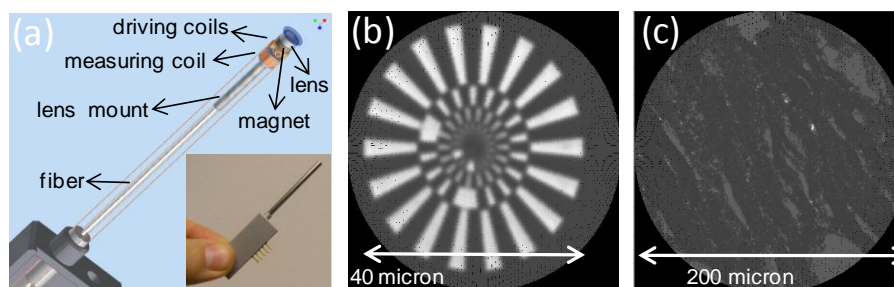
# HIGH-RESOLUTION FIBER-SCANNING CONFOCAL MICROSCOPE

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Microscopic in-vivo tissue imaging could allow for real-time discrimination of tissues relevant for disease diagnosis. In many clinical contexts, a miniature microscope is required to reach tissues deep within in the human body [1]. Here, we present a novel, single-lens, high-resolution electromagnetically-controlled fiber-scanning confocal microscope with a 3 mm outer diameter.

The fiber scanner consists of a single-mode fiber placed in a rigid cylindrical housing (see figure 1(a)). At a distance from the distal fiber end, a miniature aspherical microscope objective lens is attached to the fiber via a lens mount. The objective lens transforms the exit light beam from the fiber into a diffraction limited focused beam having a numerical aperture of 0.68. A small magnet is fixed to the lens mount. The magnet and the lens mount are actuated by two independently driven pairs of coils mounted on the housing; they allow for accurate positioning of the fiber/objective lens combination within in the housing. An additional measuring coil is attached to the lens mount to measure the position of the lens with respect to the housing. In order to do that, two high-frequency electrical signals are added to the driving signals of the driving coils. Broadband laser light centered at 780 nm is coupled to the proximal end of the fiber to illuminate tissue in front of the scanner. The light reflected back from the tissue is coupled by the objective lens into the distal fiber end and is guided to a light detector at the proximal end of the fiber via an optical circulator. By scanning the objective lens in the housing, a microscopic image of the tissue in front of the scanner is obtained. In resonant mode, a circular field of view with a maximum diameter of 200 microns can be imaged. The designed actuator allows both resonant and non-resonant scanning modes. The resonance frequency of the scanner was found to be 130 Hz. In figure 1(b), an image acquired from a resolution target is shown, revealing a lateral resolution below 0.6 micron. In figure 1(c), a reflectance image of a swine myocardium tissue sample is shown. Having high spatial resolution in combination with resonant and non-resonant scanning modes makes this miniature microscope especially interesting for future miniature microscopes incorporating two-photon imaging.



**Figure 1:** (a) A drawing (outer housing removed) and a photo of the fiber scanner with 3mm outer diameter, (b) an image of a resolution target and (c) an image of a swine myocardium tissue sample.