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ABSTRACT

This work report an electro-thermal micro-electro-mechanical system (MEMS) fiber scanner for endoscopic optical coherence tomography (OCT) imaging. The electro-thermal MEMS actuator is composed of a micro-platform, a group of bimorph actuators and a substrate. At first, a 40 mm long bare fiber was fixed on the actuator while keeping the distal end tip free. The micro-platform was then, attached with the fiber at 20 mm apart from the fixed end. Electro-thermal bimorph MEMS actuator with large vertical displacement realizes 1-D forward optical scanning up to 3 mm of scanning range with only 5 VACp-p and 2 VDC operation voltages. The electro-thermal MEMS fiber scanner was combined with the high speed FDML-based swept-source OCT (SS-OCT) system and demonstrated its capability of performing cross-sectional imaging. The FDML laser source has a central wavelength of 1310 nm and a full wavelength sweeping range of ~ 150 nm, which provided an axial resolution of ~ 9.3 to 9.5 μm in air. The FDML sweeping frequency was 220 kHz, and the OCT imaging frame rate was synchronized with the resonant frequency of the MEMS fiber scanner (~88 frames per second). Due to the high actuation force of the electro-thermal actuation, proposed MEMS fibers canner can scan the fiber tip to a millimeter range with low actuation voltages and thus may have potential of performing raster scan with non-resonant fiber cantilevers directly.

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