An optical transformer-based Campanile near-field probe on an AFM cantilever

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Near-field scanning optical microscopy (NSOM) is a powerful and unique approach to characterize the chemical, physical and biochemical properties of materials with the nanometer scale resolution in real-time. NSOM has so far played only a niche role as characterization technique due to one main bottleneck: The need of reliable, efficient, and broadband near-field probes. An optical transformer-based Campanile near-field probes are a novel class of nano-optical tips, which proved to operate extremely reliably, can be employed by non-experts, are completely independent of the substrate type, and combine superior performance in terms of spatial resolution, near-field enhancement, bandwidth, and signal to noise ratio. Since the invention of the probes, the tips have been successfully used for multidimensional spectroscopic imaging of nanostructures with nanoscale resolution, providing so far in-accessible insights into optoelectronic process. The original probes are fabricated on top of an optical fiber. Our aim is to develop the fabrication technology to incorporate the Campanile optical transformer into a standard atomic force microscopy (AFM) platform as a novel class of NSOM probes.

We report a realization of Campanile near-field scanning optical probe on an AFM platform. The fabrication process was based on standard micro-lithography techniques allowing a straightforward production of multiple cantilevers on a wafer scale. Figure 1 shows a scanning electron micrograph (SEM) image of an optical transformer on a cantilever. The measured resonance frequencies of the AFM cantilevers are in excellent agreement with theoretical calculations over different cantilevers as shown in Figure 2, which justifies our characterization. This work paves the way for low cost and reproducible manufacturing of near-field probes suitable for high-resolution hyperspectral imaging.

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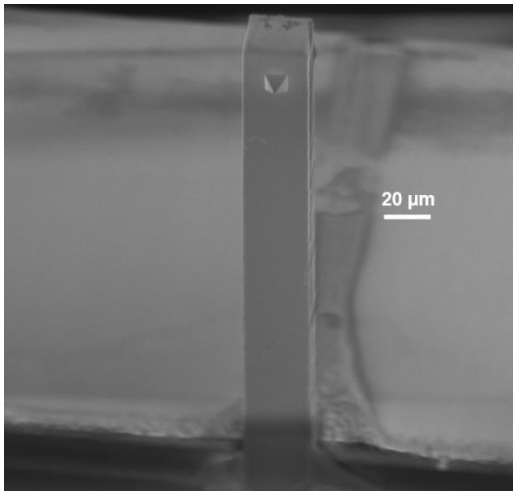

Figure 1 SEM of Campanile near-field scanning optical probe fabricated on an AFM cantilever

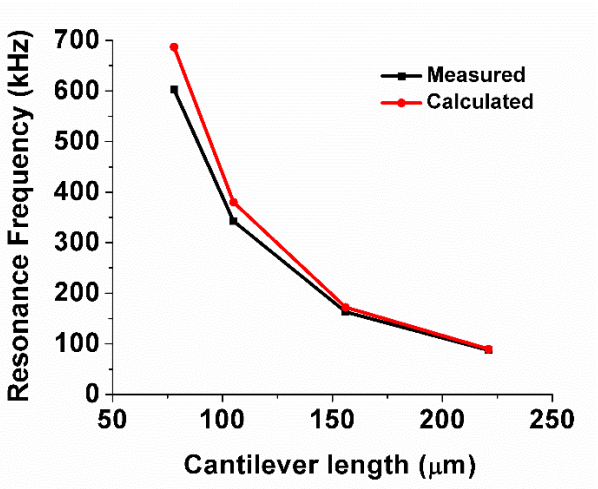

Figure 2 Experimental measurement and theoretical prediction of resonance frequencies of AFM cantilevers for various cantilever lengths.