Polymer Microtip Bridge Between Two Optical Fibers Integrated in a V-Groove

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Abstract The optical fiber microtips can be utilized as a unique platform for various applications, including optical coupling, sensing, beam shaping and optomechanical systems. Here, we fabricate a polymer microtip between two SMFs and the whole device is integrated in a V-groove which is portable and reusable. Characteristics of the microtip bridge will be discussed. This integrated portable device can be used in various coupling and sensing applications.

Bachelot et al. [1] introduced a method to fabricate fiber-based polymer microtips. The optical fiber microtips can be utilized as a unique platform for various applications, including optical coupling [2], sensing [3], beam shaping and opto-mechanical systems.

Different approaches to fabricate polymer microtips between two fibers were demonstrated using photopolymerization [4]. A polymer bridge was constructed between the fiber ends through injecting actinic light from two counter-propagating optical fibers, which realized low loss coupling [5]. Polymer waveguides with different lengths were fabricated between two single mode fibers (SMFs) using single photon polymerization via a xenon lamp instead of a monochromatic laser source [6]. However, these methods all require a sophisticated 3D alignment system that is bulky and may not be convenient to use.

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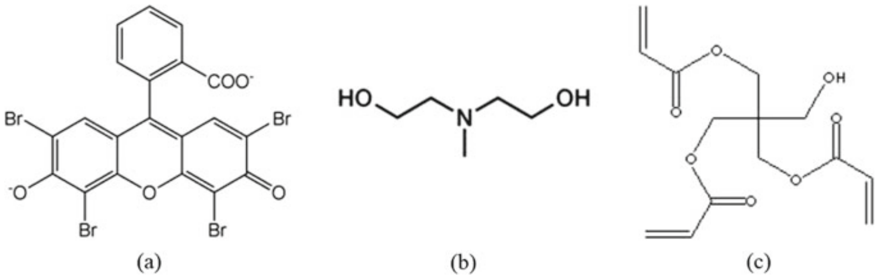

Fig. 1 Molecular structure diagrams of **a** eosin Y, **b** MDEA, **c** PETIA [1]

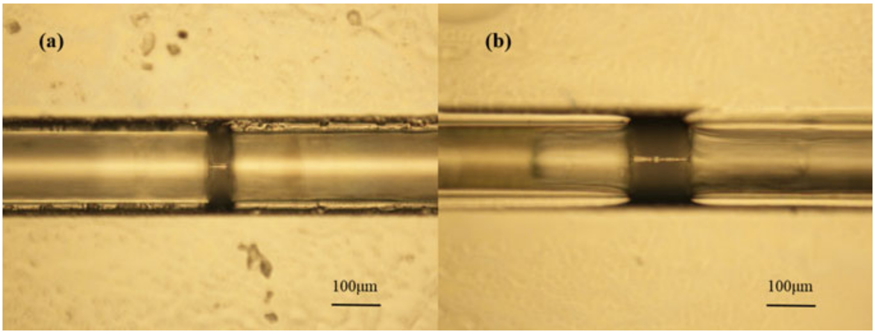

Fig. 2 Microscope images of two microtip bridges with different lengths between SMFs **a** 38 μm, **b** 108 μm

Here, we fabricate a polymer microtip between two SMFs, and the whole device is integrated in a V-groove which is portable and reusable. To fabricate a microtip, we should prepare photopolymer reagent first. The photopolymerizable reagent is made up of three basic components: a sensitizer dye, an amine cosynergist and a multifunctional acrylate monomer. In this experiment, we use 0.5% in weight of eosin Y, 8% in weight of methyldiethanolamine (MDEA) and 91.5% in weight of pentaerythritol triacrylate (PETIA), as shown in Fig. 1 [1].

After two SMFs were placed and fixed in a V-groove at a certain distance from each other, a drop of liquid reagent was deposited in the gap between SMFs. Then, the green laser was coupled in the SMF on the left hand, and laser light emerging from the core of the SMF solidifies external photosensitive material. A polymer microtip bridge therefore grew between cores of two SMFs within the unreacted liquid, and the unreacted liquid was then washed off by a few drops of ethanol.

We can control the microtip length conveniently by placing two SMFs at a set distance. Besides, through adjusting green laser power and laser exposure time, we can get microtips with different diameters. Figure 2 depicts microscope images of two microtip bridges between SMFs with different lengths. The laser power was 3 μw, and the exposure time was 120 s. The microtip bridge ensures light propagation over

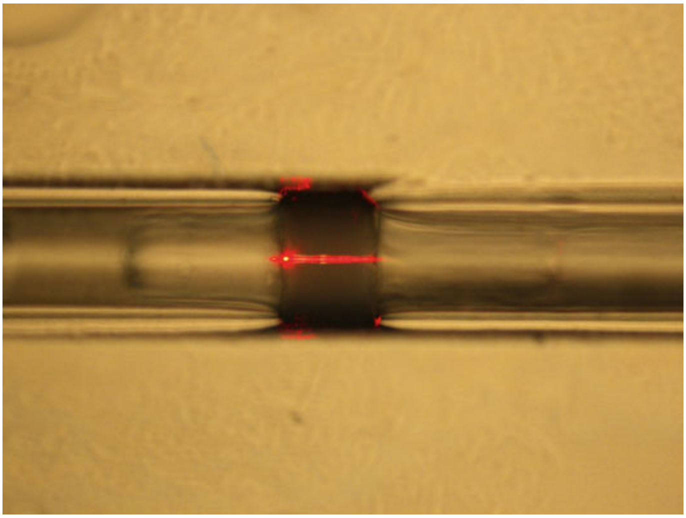

Fig. 3 Microscope image of a photopolymer microtip bridge carrying some red light

a broad bandwidth ranging from 406 to 1550 nm. Figure 3 shows the photopolymer microtip bridge in Fig. 2b carrying some red light.

When the laser power was 3 μw and the exposure time was 90 s, the tip base was about 13 μm with the length of 82 μm. At a wavelength of 532 nm, this microtip achieves the lowest loss transmission with 0.25 dB loss.

We have fabricated polymer microtips between two SMFs, and the whole device is integrated in a V-groove which is portable and reusable. This integrated device can be used in various coupling and sensing applications.

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