Realization of nanophotonic quantum devices using a He ion microscope

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In order to realize photonic quantum computers and quantum network, it is important to develop photonic quantum devices, such as single photon sources, quantum memories, and quantum phase gates. For the realization of them, nanophotonic quantum devices, which are nanophotonic devices coupled with single light emitters, have been attracted attention. As the nanophotonic quantum devices with high coupling efficiency of photons from the single light emitter into a single mode fiber, we have developed optical nanofibers coupled with the single light emitters [1-4]. To improve the coupling efficiency, we have recently developed nanofiber Bragg cavities (NFBCs), which are the optical nanofibers embedded an optical microcavity in it [5, 6]. However, experimentally achieved quality (*Q*) factors of the NFBCs have been still a few hundred.

To improve the *Q* factors, we have fabricated the NFBCs using a helium ion focused ion beam (FIB) [7]. Figure 1(a) shows a scanning ion microscope (SIM) image of the NFBC. The cavity structure, which consisted of a defect and the periodical grooves, is observed. Figure 1 (b) shows the measured transmission spectrum of the NFBC. A sharp resonant peak with the *Q* factor of 1260 is appeared in the center of the stop band. This *Q* factor is more than 4 times larger than the NFBC fabricated with a gallium ion FIB.

Besides these results, we will discuss the NFBCs when the number of the grooves is changed and the comparison with finite-difference time-domain (FDTD) simulation.

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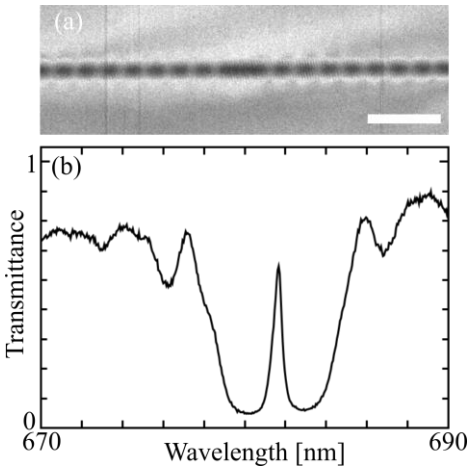

Fig. 1 (a) Scanning ion microscope image. The length of the white bar is 1 μm. (b) Transmission spectrum of the NFBC.