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Author(s)	Mizunami, Toru; Kimura, Takuto
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Second-Harmonic Generation in Thermally Poled Twin-Hole Silica-Glass Fiber: Quasi-Phase Matching with Mercury-Lamp Exposure and its Optimization by Fiber Stretch

Toru Mizunami* and Takuto Kimura

Department of Electrical Engineering and Electronics, Graduate School of Engineering,
Kyushu Institute of Technology, 1 Sensuicho Tobata Kitakyushu, 804-8550, JAPAN

e-mail: mizunami@elcs.kyutech.ac.jp

Silica glass is highly transparent oxide used for optical fibers. By applying a high electric field at high temperature, an electrical conductivity is induced, ionic impurities or defects are separated, and then the second-order optical nonlinearity is induced by the internal electric field. Thus, the second-harmonic generation (SHG) in silica fiber becomes possible. However, the SH waves generated from various positions along a fiber cancel each other. To avoid this, quasi-phase matching (QPM) is performed. The QPM of poled fibers is performed by periodic erasure of nonlinearity by ultraviolet-laser exposure with a period in agreement with the coherence length. On the other hand, a low-pressure mercury lamp emits the light of 254 nm and low-cost. The QPM by a mercury lamp was studied on a D-shaped fiber [1]. The QPM output was increased by compression of a QPM fiber [2] with a better agreement of the period and the coherence length. The present authors reported the QPM of a twin-hole fiber with a mercury lamp [3]. Here, we stretched the QPM fiber and measured the increase in the SH output.

In the experiment, we put electrode wires into the side holes of a twin-hole fiber and applied a voltage of 2.5 kV at 300 ºC for 40 min. The QPM was performed as shown in Fig. 1 by exposure with a mercury lamp thorough a stripe pattern mask. The SHG measure ment was performed as shown in Fig. 2. A *Q*-switched Nd:YAG laser beam (1.06 μm) was coupled to a fiber, and the SH output was measured with a photomultiplier through a 0.53-μm filter stretching the QPM fiber. Figure 3 shows the results for four samples. The SH power increased by a factor of up to 1.8.

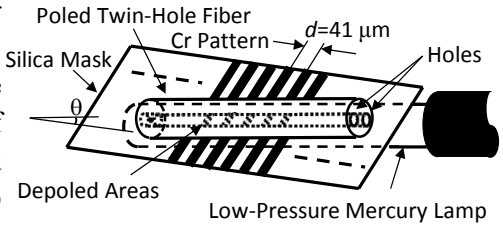

Fig. 1 Setup for quasi-phase matching of thermally-poled silica glass fiber.

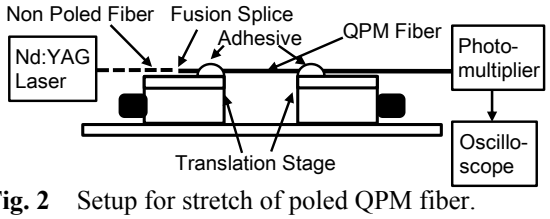

Fig. 2 Setup for stretch of poled QPM fiber.

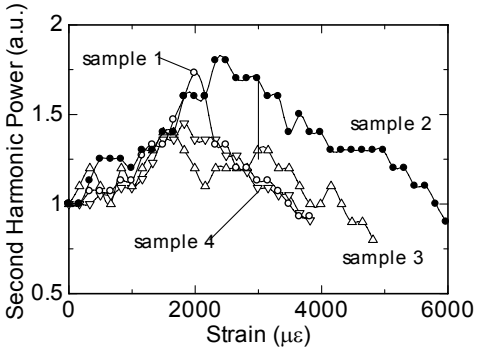

Fig. 3 Dependence of SHG output on strain by stretch of poled QPM fiber.

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