1. Light Coupling and Fiber-end Preparation

(Dated: December 24, 2020)

I. OBJECTIVE

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(I) Preparation of properly cleaved fiber end.
(II) Proper coupling of light into fiber.

II. APPARATUS

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1. Optical breadboard
2. He-Ne Laser and Laser aligner
3. Microscopic objective (20X) and holder
4. xyz-translational stage
5. Photodetector with multimeter and holder
6. Two fiber chucks
7. 2 post bases and 3 posts
8. Single-mode and Multimode fiber of appropriate length
9. Fiber cleaver.

III. THEORY

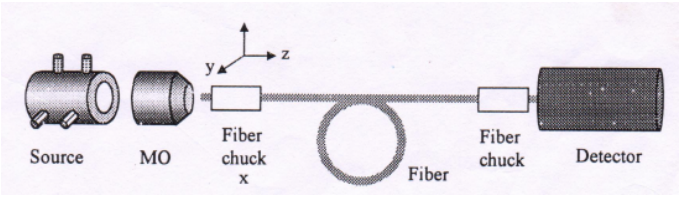

FIG. 1. Experimental setup for launching light from laser into optical fiber using an MO

A. Using MO as lens

Let's consider that a collimated beam of light is incident on the input aperture of the MO, filling it completely. The numerical aperture of the lens is given by:

$$NA = \frac{a}{f} = tan(\theta_a) \cong sin(\theta_a)$$

for a given diameter of the front end lens of the MO, smaller NA implies larger focal length and vice versa. NA of a MO is important to know as it gives us focal length and where the fiber must be put in order to achieve maximum coupling as shown in the following figure:

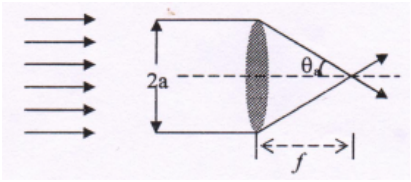

FIG. 2. representation of MO of focal length f and aperture $sin(\theta_a)$

IV. EXPERIMENTAL PROCESS

In this section, the processess that were followed during the experiments are discussed:

A. Setting up Laser and coupling of light into MO

Laser was mounted on a laser aligner and was leveled horizontally using spirit level and turned on, then MO was setup by mounting it in the MO holder and fixing it on optical breadboard such that the axes of laser and MO almost coincides. After that, a screen was placed in front of MO, and approximately maximum coupling was observed visually (and later using photodetector) by doing fine adjustment in MO position using translational screws in MO holder.

B. Preparing fiber ends

A multimode fiber of approximately 0.6m in length was taken. At first on one end, the coating on the fiber was taken off for a couple of centimeters using Miller's pliers of which diameter screw was preset corresponding to the fiber's diameter. After stripping off the outer jacket, the rest of the traces of the protective layer was removed using wiping the exposed part of fiber with tissue paper soaked in Isopropyl Alcohol.
Then a fiber cleaver and breaker(shown in the following figure) was used for preparing the end of the fiber.

The fiber was inserted in the cleaver in such a way that the plastic coated stops at stopper. Then the non coated part was fixed using the rubber clamp and the support was bent along with fiber to provide sufficient tension. Then ceramic blade was pressed and the fiber

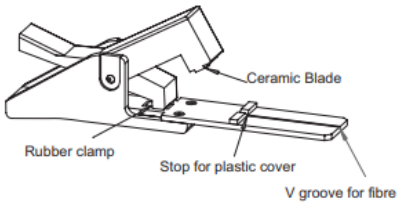

FIG. 3. Fiber breaker and cleaver

was cleaved. The same process was repeated for the other end of the fiber too.
On coupling light into the fiber, if the output image on the screen was not circular, that meant that the ends was not cleaved properly, and the process was repeated again to get a good output as shown in the figure below

FIG. 4. Output image of a good cleaved end

C. Coupling of light into fiber

Two xyz translational stages were fixed on the optical board with fiber chucks and magnets. 1^{st} one was about 1cm away from the MO in order to keep the fiber end near the focus of MO to ensure maximum coupling. While on the other end the photodetector was mounted on post base and the 2^{nd} translational stage was fixed near it. Then one end of fiber was fixed on the 1^{st} stage using magnets to keep it in place and the other one was fixed on the 2nd stage. Now, using the x,y and z screws, the fiber distance and position was changed continuously in order to obtain maximum output on the other end which is detected by using the photodetector. It was seen that maximum coupling was obtained in between 3-4 mm distance from the MO, which should be the case according to the provided information on the MO.

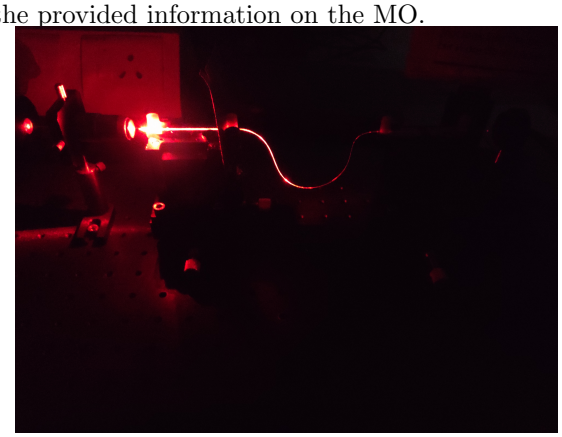

FIG. 5. Light coupling into fiber

V. RESULTS AND DISCUSSION

1. Properly cleaved ends of fiber were obtained after 2-3attempts. And for the rest of the experiment, a different cleaver with circular blade was used.
2. Coupling of light into the fiber was successful, and maximum output intensity point was achieved.

[1] YOLUX setup application manual,*School of Physical Sciences,NISER*