Semiautomatic platform for Fabry-Perot microcavities construction

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ABSTRACT

A semi-automatic and reconfigurable mechatronic stage was designed and implemented to precisely control the fiber cleaving in the process of manufacturing Fabry-Perot (FP) microcavities. FP interferometers with a cavity length as small as 5 µm, were achieved with this system. The theoretical reflectance of the fiber cavities was studied by the interference phenomenon simulation. Then, a comparison technique between the experimental and simulated spectra was performed to calculate the length of this FP cavities fabricated. The FP cavities presented can be used to develop sensor in many fields; ranging from the industrial to sensing applications.

FUNDAMENTALS OF THE FIBER OPTIC FABRY-PEROT INTERFEROMETERS (FFPI)

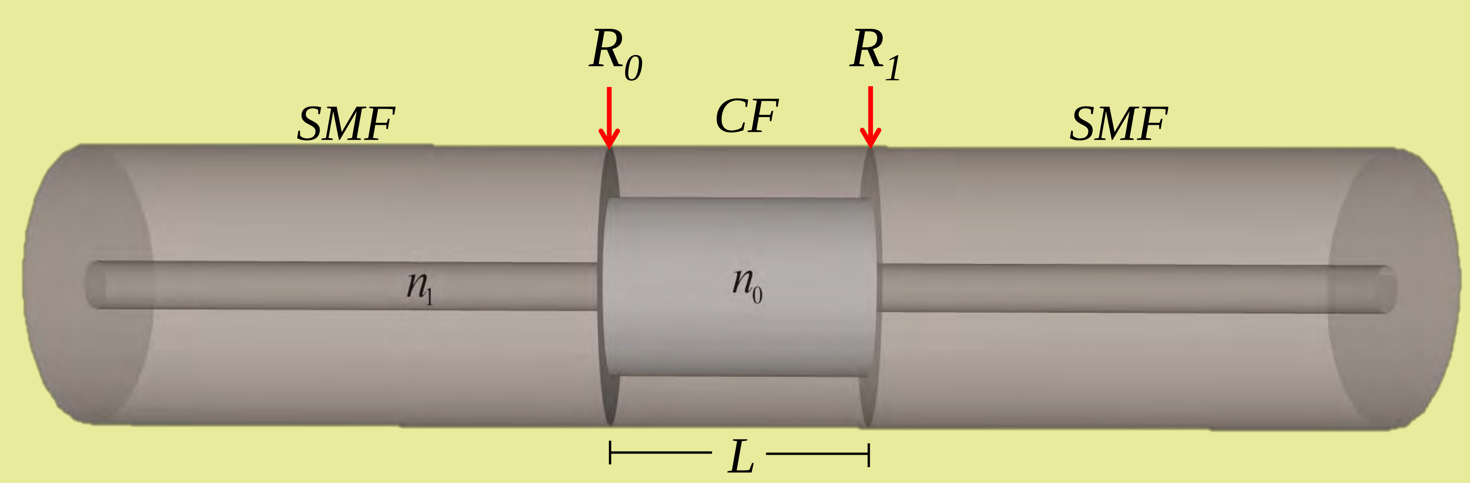

Fig. 1. Basic scheme of a FFPI, consisting in a capillary fiber spliced between two SMFs.

$$R = R_0 + (1-R_0)^2 R_1 + 2(1-R_0)\sqrt{R_0 R_1}\cos(2kn_0 L_1 + \varphi) \qquad (1)$$

PLATFORM DESIGN AND FABRICATION

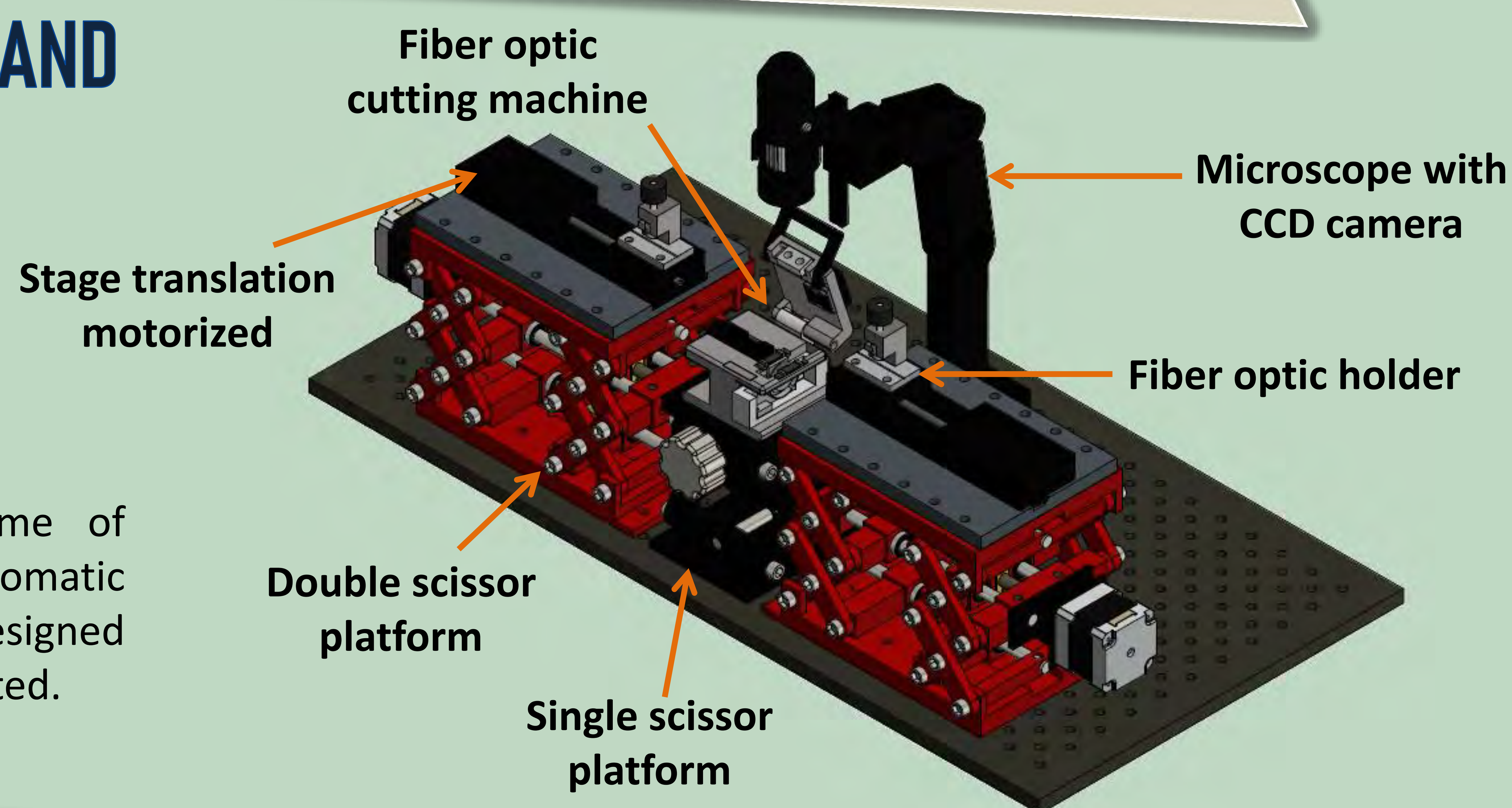

Fig 2. Scheme of the semiautomatic platform designed and constructed.

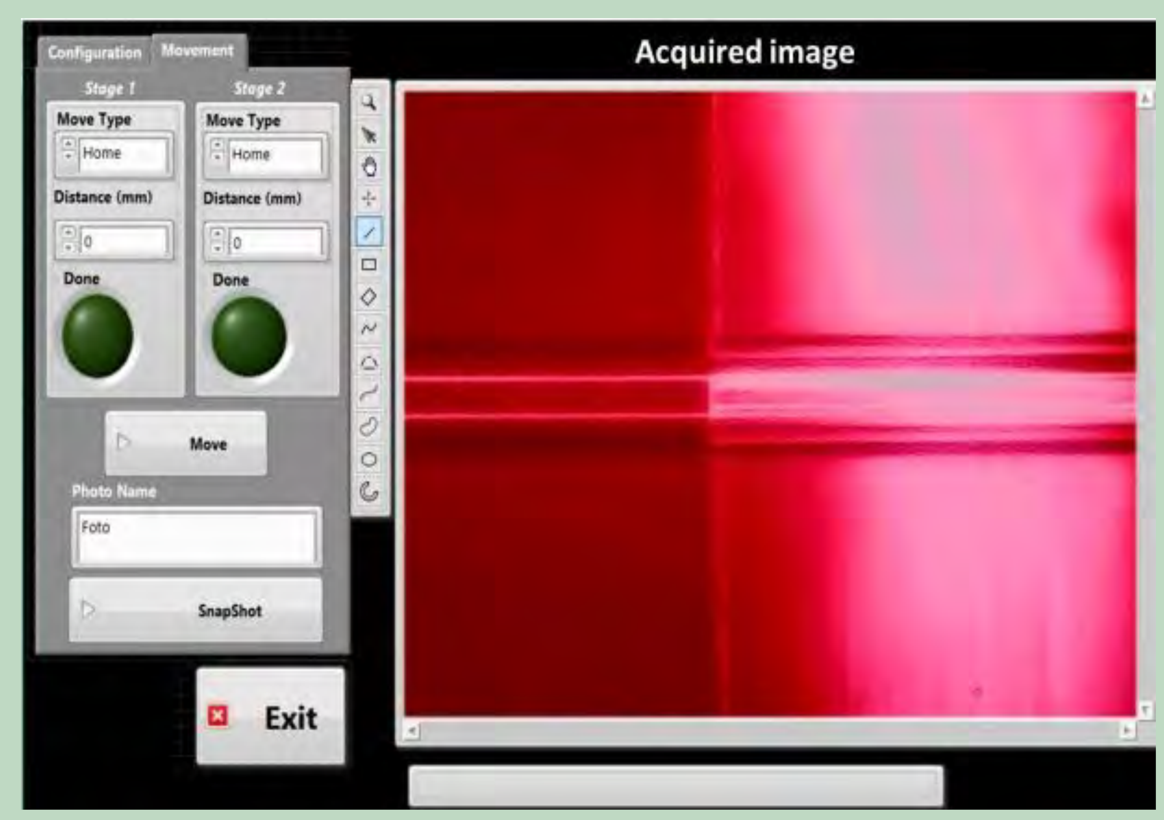

Fig 3. Screen of the computer interface, where the image of the fiber splice is aligned with the blade of the cleaver is displayed.

FABRICATION AND CHARACTERIZATION OF FABRY-PEROT CAVITIES

Table 1. Calculated lengths of the cavities FP constructed.

No.	L_1 [µm]
1	4.92
2	5
3	5.1
4	5.178
5	5.401
6	5.429
7	6.452
8	6.483
9	7.0755
10	7.22
11	7.396
12	7.455
Standard deviation	0.97
Mean	6.625

In order to investigate cavity lengths, their experimental reflectance was obtained using an interrogator *MICRON OPTICS, SI255*. Then using Eq. (1), a spectrum simulation was performed, sweeping the length until it was fitted with the experimental.

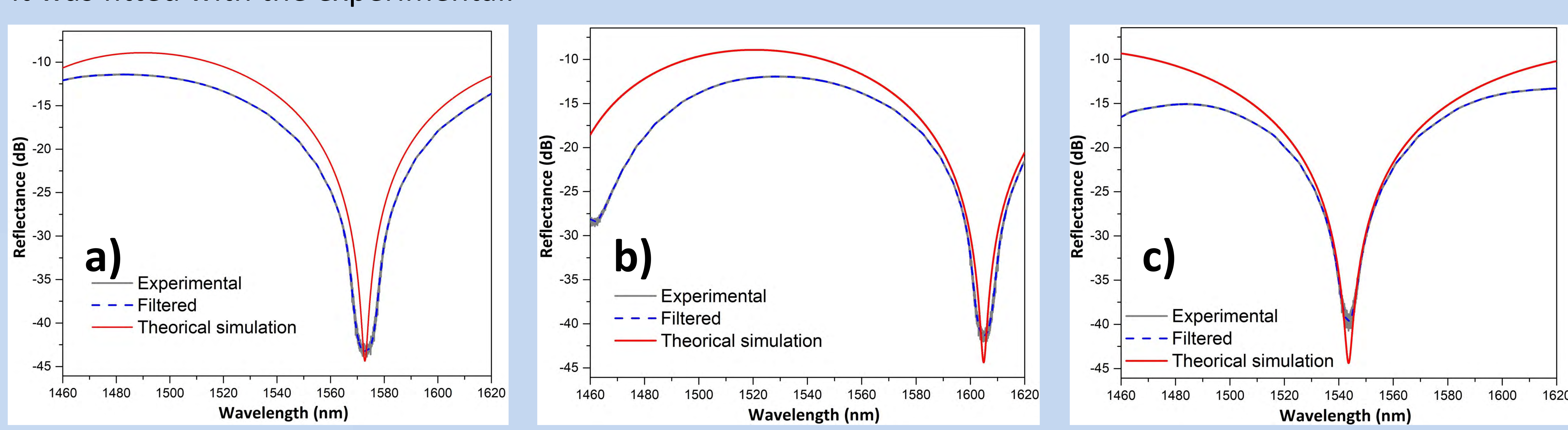

Fig. 4 Comparison of the measured reflectance with its theoretical approximation, for three different cavities a) 5.401 µm, b) 7.0755 µm and c) 7.22 µm.

CONCLUSION

A semi-automatic platform was designed and built to manufacture FP cavities in a simple and repeatable way. FFPI were fabricated and the experimental spectra were compared with the simulated spectra calculated from the interference model. It was shown that it is possible to build FP cavities up to 4.92 µm. The final cavity length was estimated comparing the simulated and experimental spectra. This platform allowed us to fabricate FFPI to develop high sensitivity strain sensors and other physical variables.