

Virtual Vernier effect-based high sensitivity optical fiber humidity sensor

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Abstract

This paper presents an optical fiber-based humidity sensor which has tunable sensitivity by using virtual Vernier effect. It is formed by splicing a short length of hollow core fiber (HCF) at the end of a single-mode fiber (SMF) and fabricating a membrane of Polyvinyl Alcohol (PVA) /Polyacrylic Acid (PAA) at the end of HCF for humidity sensing. The experimental data of the proposed sensor shows that the sensitivity of -140 pm/%RH is achieved. Then the virtual Vernier effect is applied for data processing of the humidity sensor and the sensitivity is amplified with an adjustable amplification factor up to 20. The maximum achieved sensitivity is -2.875 nm/%RH.

Sensor structure

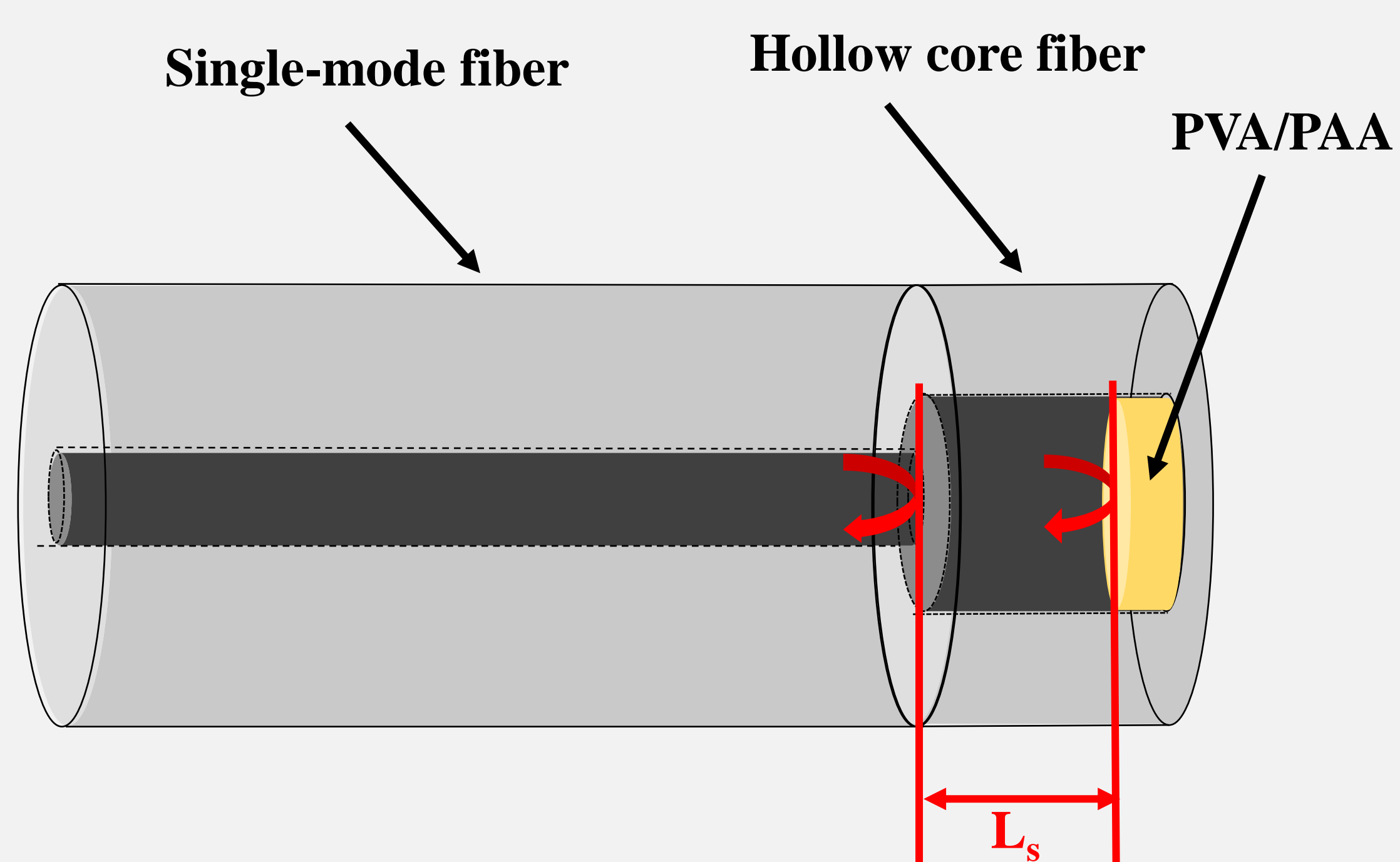


Fig. 1 Schematic diagram of the proposed FPI humidity sensor head

Experimental diagram

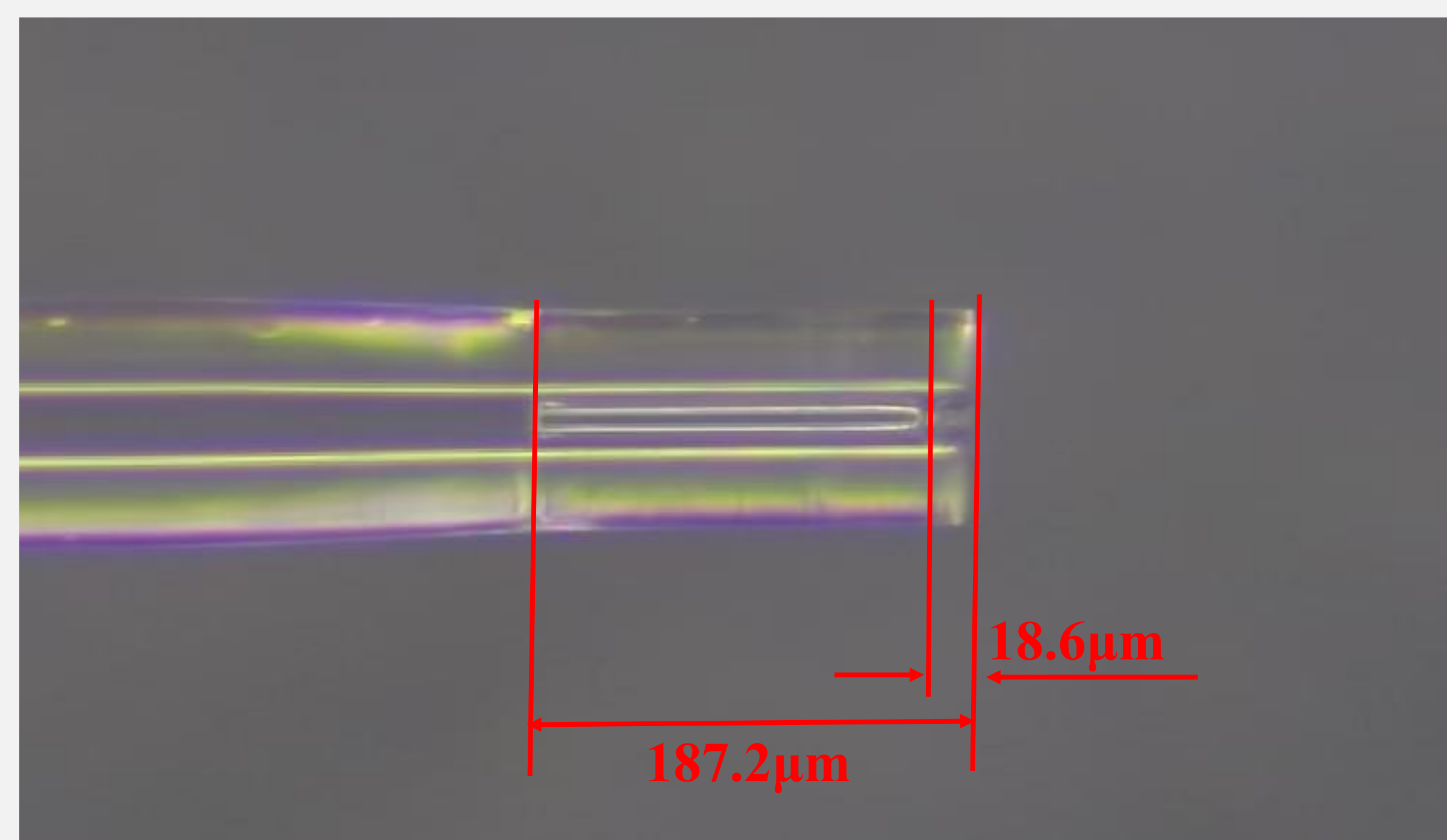
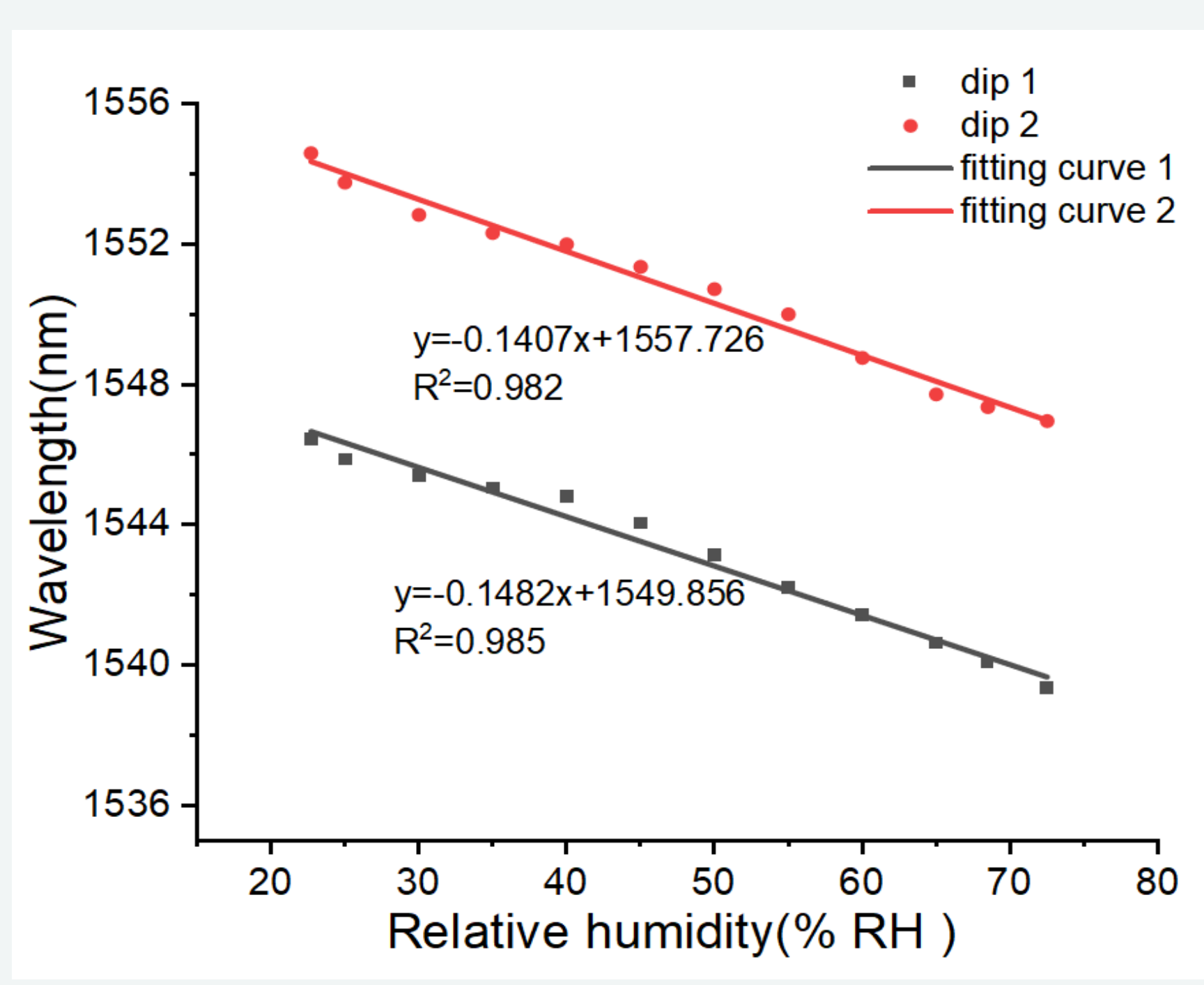
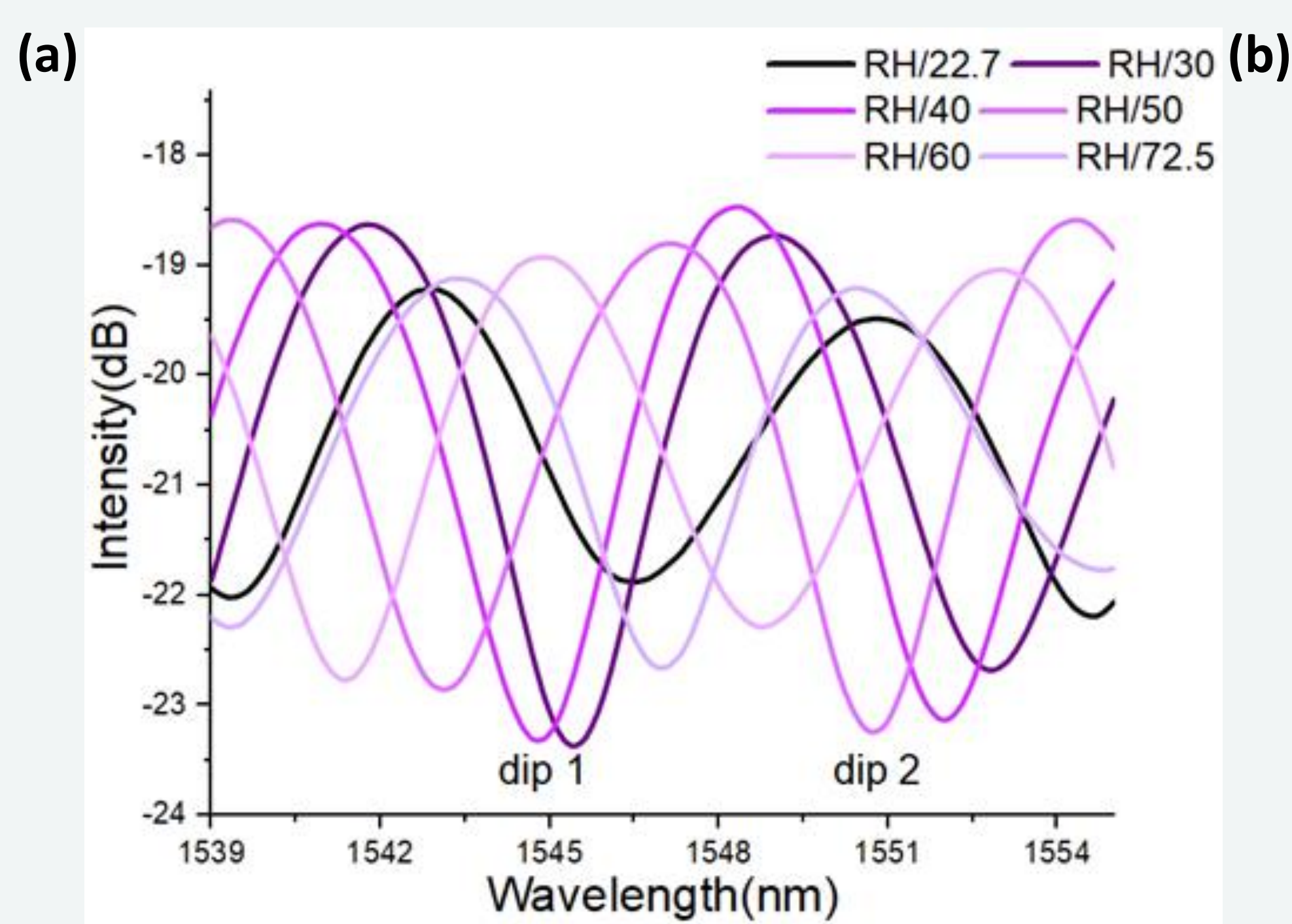
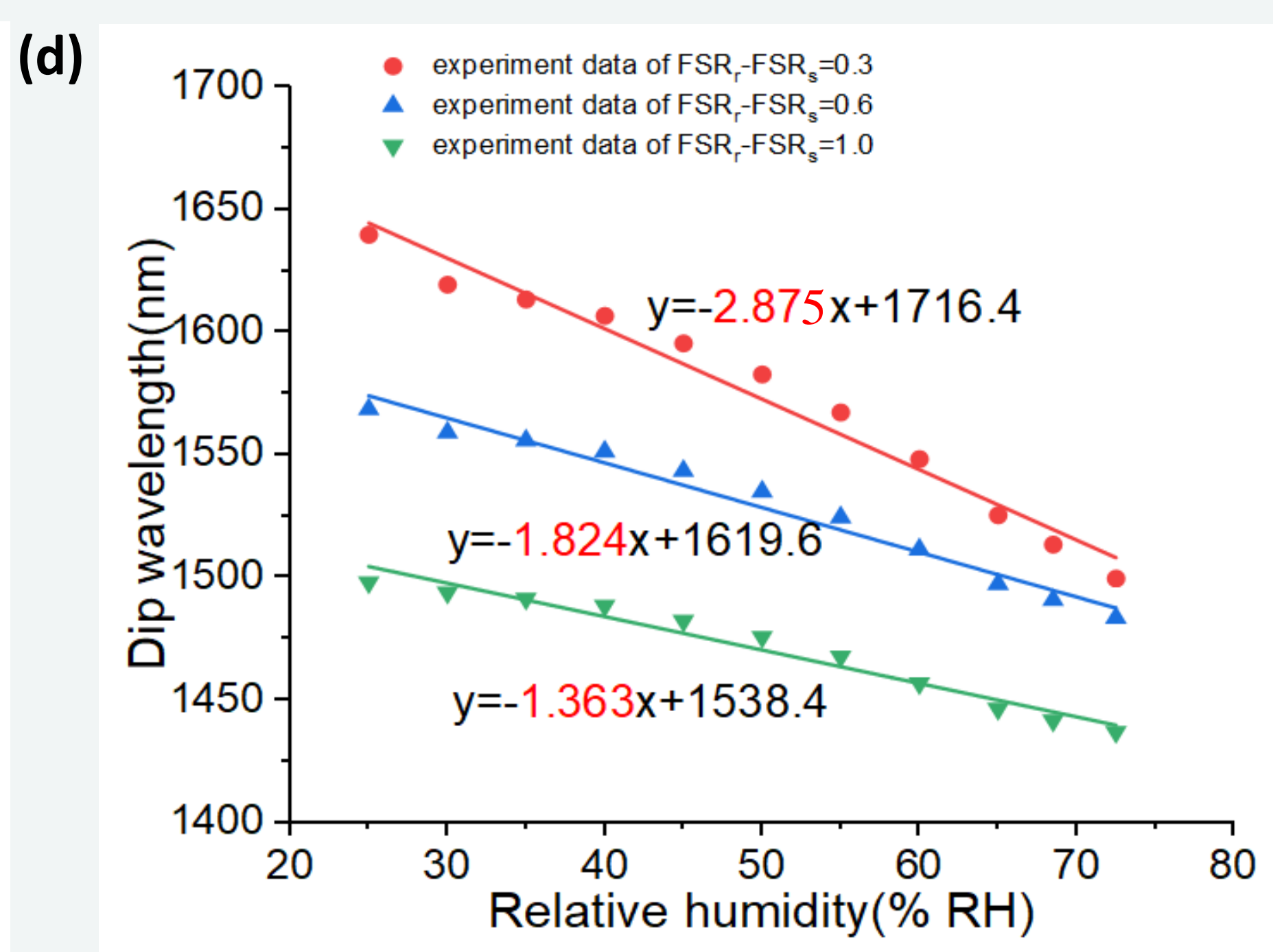
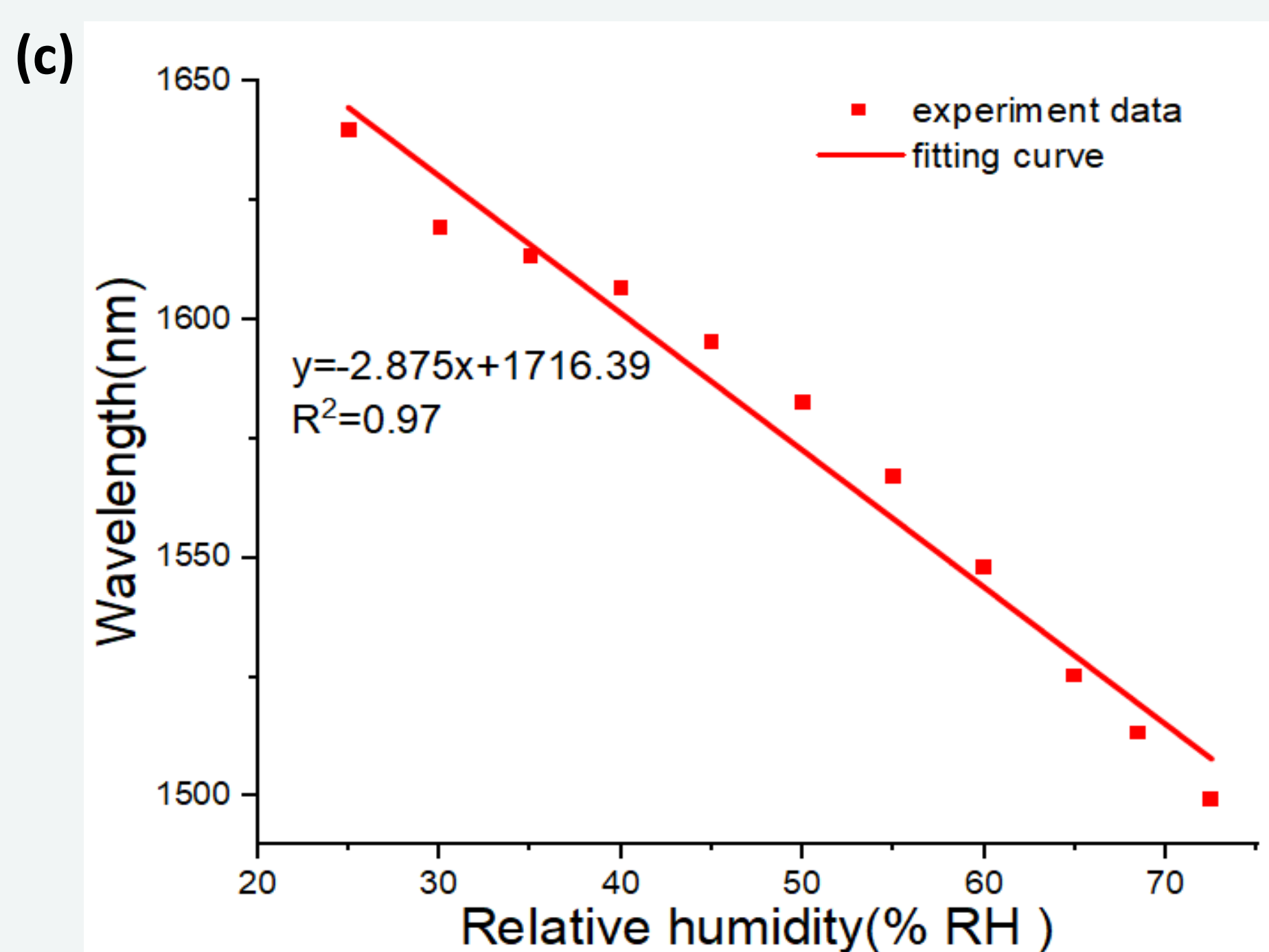


Fig. 2 Image of the proposed RH sensor under the microscope

Experiment results



(a) (b): Spectrogram and linear fitting diagram of the proposed sensor. When the relative humidity increases from 25%RH to 80%RH, the wavelength shift of the proposed sensor has a blue shift, and its sensitivities are 0.148 nm/%RH



(c) (d): The linear fitting of the dip wavelength versus RH varying based on virtual Vernier effect with different magnification. the sensitivity of -2.875 nm/%RH is 20 times higher than the single RH sensor, the precisely controlling the signal of the reference interferometer can be realized via computer for enhancing the sensitivity of the RH sensor.