A point-of-care testing device utilizing graphene-enhanced fiber optic SPR sensor for real-time detection of infectious pathogens

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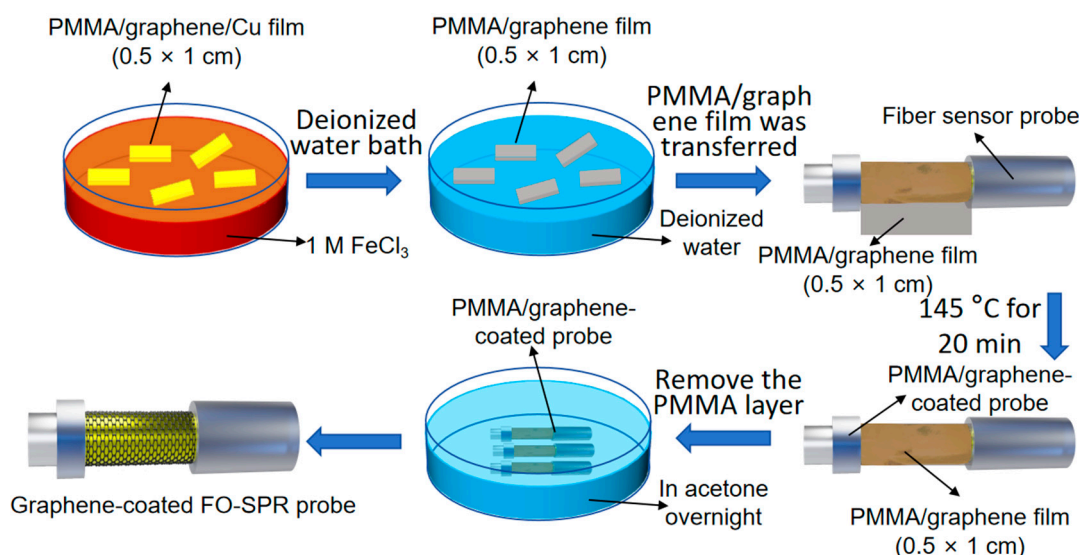
Figure S1. Scheme of the graphene-coated FO-SPR sensing probe.

11-MUA-modified FO-SPR sensing probes.

The FO-SPR sensing probe with bare gold was immersed in 1 mM 11-MUA in ethanol at room temperature overnight and alternately rinsed with ethanol and deionized water. Then, to activate the carboxyl group, the FO-SPR probe was placed in an aqueous 0.5 M NHS/EDC solution for 20 min and rinsed with deionized water. The sensing probe was immersed in 250 µg/mL SARS-CoV-2 spike S1 antibody in PBS for 45 min. Finally, the probe was put in 1 mg/mL BSA for 1 h.
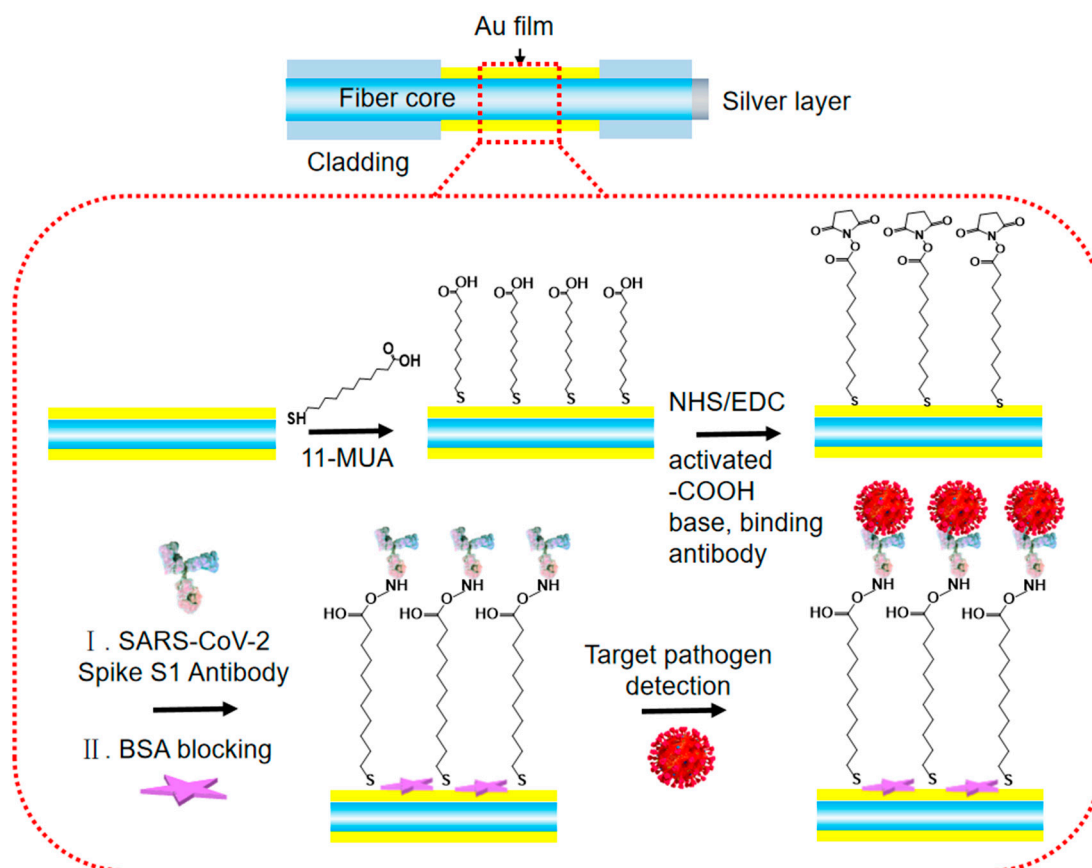
Figure S2. Scheme of the bio-functionalized FO-SPR sensing probe.
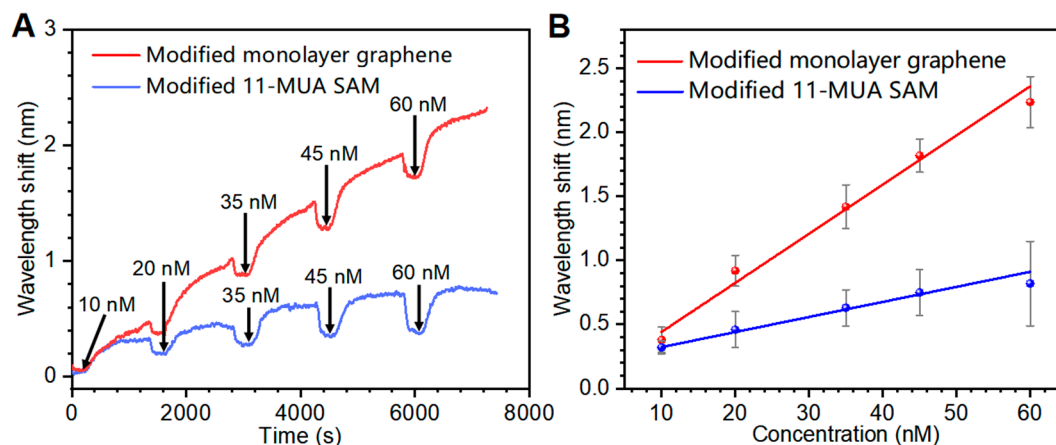
Figure S3. Testing SARS-CoV-2 spike S1 protein via portable FO-SPR device. (A) The graphene-coated FO-SPR sensing probe wavelength shift curve (red) and the conventional 11-MUA-modified FO-SPR sensing probe wavelength shift curve (blue). (B) The graphene-coated FO-SPR sensing probe (red) and the conventional 11-MUA-modified FO-SPR sensing probe (blue) were linearly fitted for different protein concentrations and wavelength shifts. Error bars were determined by the standard deviation of three tests.

Table S1. RSD for repeatability analysis.

SARS-CoV-2 spike S1 protein concentration	Relative standard deviation (RSD)	Repeatability (100%-RSD)
10 nM	22.8	77.2
20 nM	15.5	84.5
35 nM	12.2	87.8
45 nM	8.6	91.4
60 nM	6.8	93.2

Table S2. Comparison of SPR methods for biosensing analysis.

Method	Type of receptor	Target analyte	Linear range	Limit of detection	Ref
SPR	Escherichia coli	Phage T4	0 PFU/mL - 2×10^8 PFU/mL	1×10^7 PFU/mL	[1]
SPR	polyclonal antibody	Salmonella enterica	-	10^5 CFU/mL	[2]
LSPR	Casein	Trypsin	0.1 µg/mL - 100 µg/mL	4.3 nM	[3]
SPR	Hb antibody	Hb	5 µg/mL - 250 µg/mL	0.078 µM	[4]
SPR	Antibody	HIV-1 p24 capsid protein	-	4.1 ± 0.5 nM	[5]
FO-SPR	SPA	IgG	30 µg/mL - 100 µg/mL	0.5 µg/mL	[6]
FO-SPR	DNA-aptamer	SARS-CoV-2 spike protein	25 nM - 1 µM	37 nM	[7]
FO-SPR	Anti-ADM monoclonal antibody	ADM	-	0.25 µg/mL	[8]
FO-SPR POCT	SARS-CoV-2 spike S1 protein antibody	SARS-CoV-2 spike S1 protein SARS-CoV-2 virus	10 nM - 60 nM 5×10^3 TCID$_{50}$/mL - 6×10^4 TCID$_{50}$/mL	2.5 nM 2.2×10^3 TCID$_{50}$/mL	This work

LSPR: Localized surface plasmon resonance; HIV: Human immunodeficiency virus; SPA: Staphylococcal protein A; Hb: hemoglobin; IgG: Human immunoglobulin G; ADM: Adalimumab.

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