Supplementary Materials

Design and characterization of ITO-covered resonant nanopillars for dual optical and electrochemical sensing

Luca Tramarin[1,2,3], Rafael Casquel[1,2,3], Jorge Gil-Rostra[4], Miguel Ángel González-Martínez[5], Raquel Herrero-Labrador[1,3], Ana María M. Murillo[1,2,3], María Fe Laguna[1,2,3], María-José Bañuls[5], Agustín R. Gonzalez-Elipe[4], and Miguel Holgado[1,2,3,*]

[1] Optics, Photonics and Biophotonics Group, Centro de Tecnología Biomédica, Campus de Montegancedo, Universidad Politécnica de Madrid (UPM), Pozuelo de Alarcón, Madrid 28223, Spain
[2] Departamento de Física Aplicada e Ingeniería de Materiales, Escuela Técnica Superior de Ingenieros Industriales, Universidad Politécnica de Madrid (UPM), C/ José Gutierrez Abascal 2, Madrid 28006, Spain
[3] Group of Organ and Tissue on-a-chip and In-Vitro Detection, Instituto de Investigación Sanitaria del Hospital Clínico San Carlos, IdISSC, C/ Profesor Martín Lagos s/n, 4ª Planta Sur, Madrid 28040, Spain
[4] Nanotechnology on Surfaces Group, Instituto de Ciencia de Materiales de Sevilla (ICMS-US-CSIC), Américo Vespucio 49, Seville 41092, Spain
[5] Instituto Interuniversitario de Investigación de Reconocimiento Molecular y Desarrollo Tecnológico (IDM), Departamento de Química, Universitat Politècnica de València, Camino de Vera s/n, Valencia 46022, Spain
* Correspondence: m.holgado@upm.es

Table S1. Complete data of Bulk Sensing experiment for R-NPs.

| R-NPs array | Resonance position [nm] and corresponding uncertainty for liquids used | | | | | | | | | | | |
	Methanol		H2O		Ethanol		Acetic Acid		2-propanol		Cyclohexane	
5-B10_A	579.60	0.17	579.88	0.05	588.63	0.12	591.12	0.11	593.09	0.10	607.61	0.15
5-B10_B	579.90	0.13	580.05	0.05	588.94	0.06	591.66	0.10	593.40	0.07	608.23	0.09
5-B10_C	580.86	0.12	580.95	0.05	589.76	0.08	591.97	0.13	593.58	0.07	608.43	0.09
5-B10_D	580.68	0.15	580.70	0.05	589.68	0.08	592.32	0.10	593.81	0.07	608.74	0.05
5-B10_E	579.75	0.14	579.57	0.05	588.60	0.06	591.31	0.09	592.67	0.05	607.64	0.09
5-B10_F	580.43	0.13	580.19	0.05	589.19	0.08	591.99	0.10	593.23	0.06	608.23	0.07
5-B10_G	581.27	0.18	581.03	0.05	589.67	0.08	592.43	0.06	593.49	0.06	606.61	0.07
5-B10_H	581.81	0.17	581.43	0.05	590.47	0.08	592.94	0.10	594.15	0.05	609.03	0.08
23-B7_A	573.77	0.29	572.93	0.05	582.19	0.05	583.73	0.12	585.37	0.13	601.29	0.24
23-B7_B	575.29	0.12	574.07	0.05	583.23	0.07	585.20	0.07	586.70	0.07	602.24	0.06
23-B7_C	573.85	0.09	572.32	0.05	581.88	0.06	583.83	0.11	585.48	0.05	601.28	0.06
23-B7_D	574.37	0.10	572.79	0.05	582.08	0.05	584.43	0.08	585.87	0.06	601.43	0.05
23-B7_E	575.60	0.14	572.83	0.06	583.10	0.05	585.44	0.08	586.59	0.05	602.23	0.07

Table S2. Complete data of Bulk Sensing experiment for R-NPs/ITO.

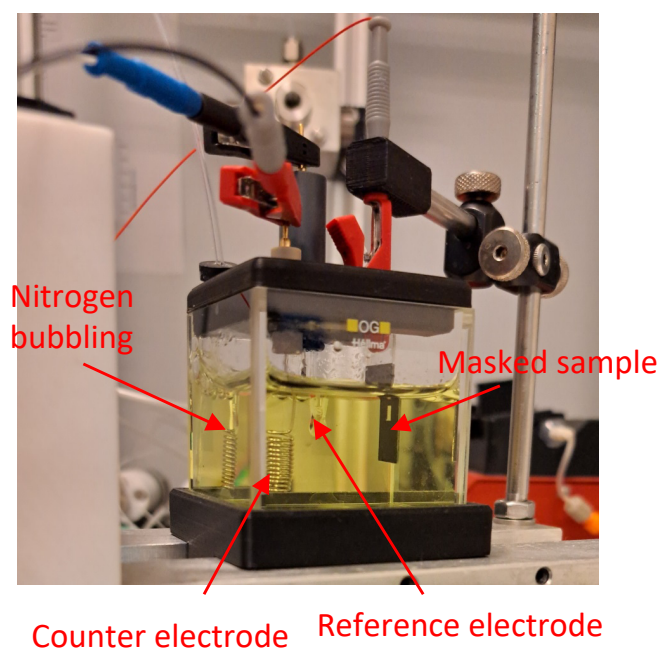| R-NPs/ITO array | Resonance position [nm] and corresponding uncertainty for liquids used | | | | | | | | | | | |
	Methanol		H2O		Ethanol		Acetic Acid		2-propanol		Cyclohexane	
5-B10_A	591.08	0.19	591.34	0.05	599.96	0.09	601.41	0.30	601.37	0.05	615.07	0.34
5-B10_B	591.76	0.09	591.73	0.05	600.45	0.05	602.12	0.05	601.77	0.06	615.75	0.05
5-B10_C	592.29	0.11	592.09	0.05	600.82	0.06	602.68	0.05	602.37	0.06	616.37	0.05
5-B10_D	592.50	0.14	592.54	0.05	601.14	0.06	602.72	0.06	602.90	0.06	616.97	0.05
5-B10_E	591.06	0.09	590.46	0.05	599.46	0.06	601.07	0.05	601.09	0.05	615.20	0.15
5-B10_F	591.86	0.11	591.29	0.05	600.24	0.07	601.63	0.05	602.04	0.06	616.06	0.06
5-B10_G	592.51	0.11	592.00	0.05	600.62	0.05	601.32	0.05	602.36	0.06	616.00	0.17
5-B10_H	593.14	0.11	592.48	0.05	601.27	0.07	602.14	0.07	603.24	0.06	617.29	0.09
23-B7_A	581.91	0.39	582.03	0.05	590.26	0.33	592.30	0.08	590.56	0.27	605.20	0.35
23-B7_B	584.44	0.26	583.86	0.05	592.26	0.06	593.87	0.55	592.81	0.06	606.92	0.08
23-B7_C	583.15	0.22	577.94	0.05	586.70	0.28	592.92	0.39	591.21	0.05	605.54	0.09
23-B7_D	583.19	0.18	581.94	0.05	590.68	0.05	591.56	0.13	591.14	0.05	606.07	0.06
23-B7_E	581.20	0.31	577.15	0.06	587.57	0.05	590.23	0.06	590.60	0.05	604.45	0.20

Figure S1. Image of the transparent electrochemical cell utilized for the characterization of the electrochemical behavior of ITO coated samples. Masked sample, counter and reference electrodes and N$_2$ bubbling system are indicated in the image.
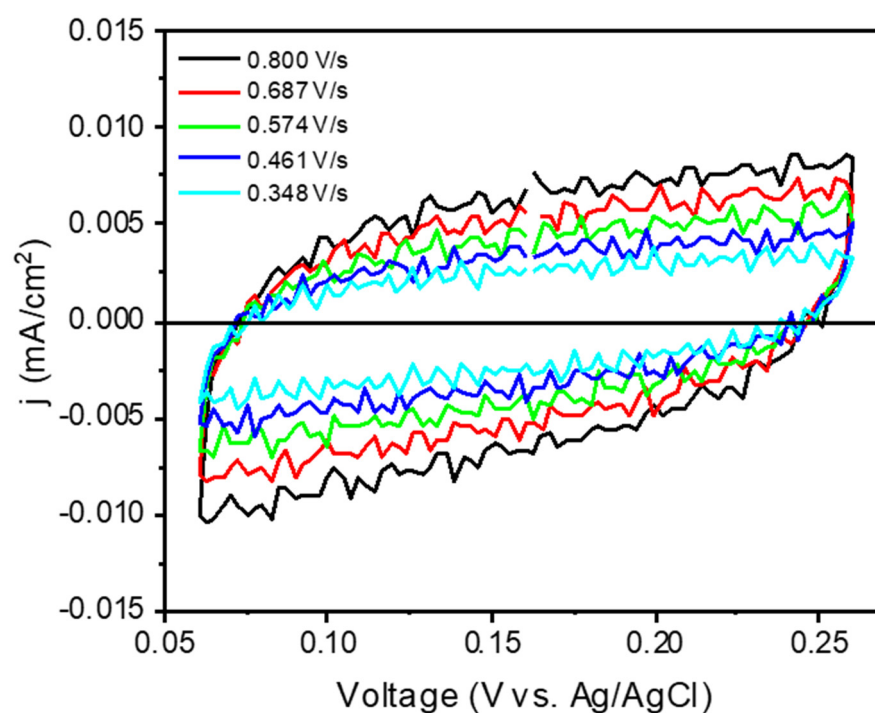

Figure S2. Voltagrams as a function of the scan rate recorded for sample R-NPs/ITO to estimate the ECSA. Similar voltagrams were also recorded for sample TF/ITO. Scan range was 0.05 and 0.25 V to avoid any Faradic contribution to the current signals and the medium was a phosphate solution, as indicated in the Materials and Methods section of the paper. ECSA values could be estimated according to the expressions: $C_{dl}=d(\Delta j)/2dV_d$ and $ECSA=C_{dl}/C_s$.
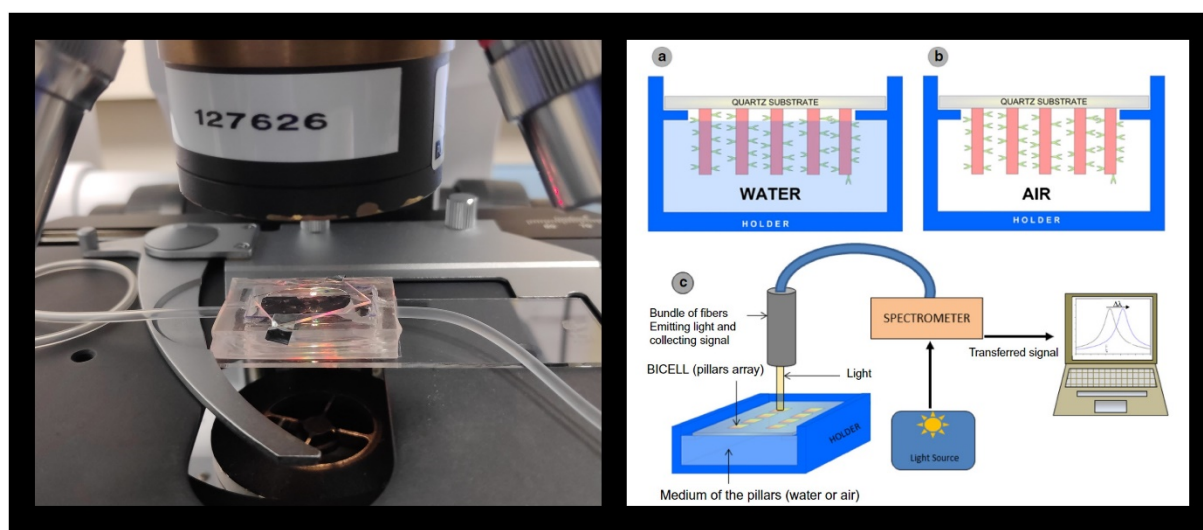
Figure S3. Optical measurement - picture of the experimental setup (**left**) and a schematic figure of the procedure (**right**, from [1]), including: (**a**) scheme of pillars immersed in water, (**b**) scheme of pillars in dry conditions, and (**c**) layout of the measurement system.
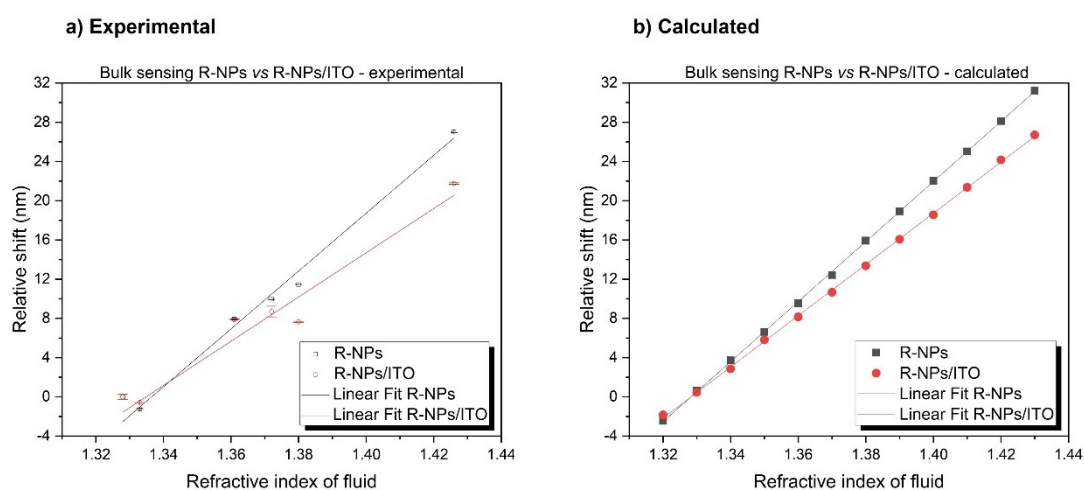

Figure S4. Resonance shift as a function of the fluids RI, before and after ITO deposition: (**a**) experimental data, (**b**) calculated results.
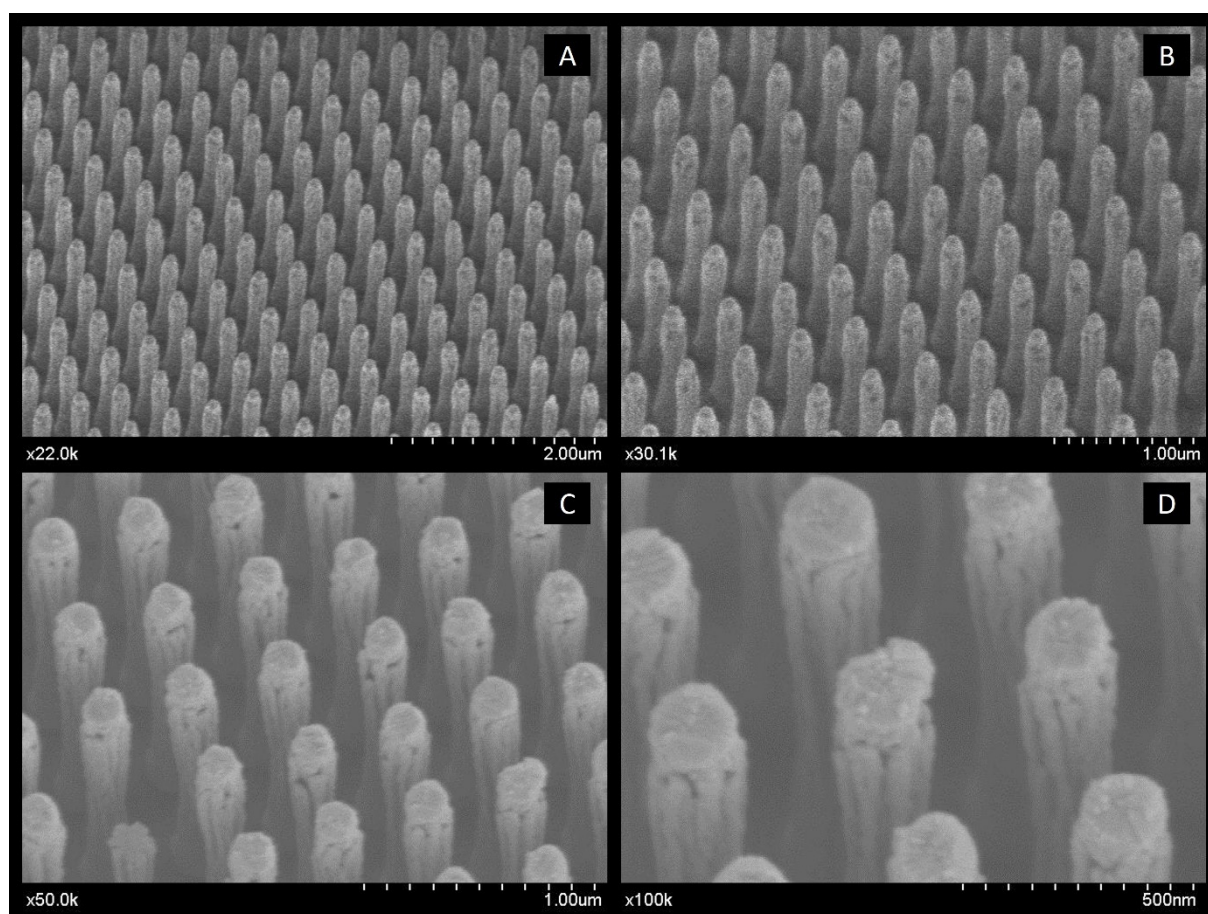
Figure S5. SEM imaging of R-NPs (**A** and **B**, before ITO deposition) and R-NPs/ITO (**C** and **D**, after ITO deposition). Both the increase in diameter and the change in shape directly suggest a correct deposition of ITO thin film on top of the nanostructures.
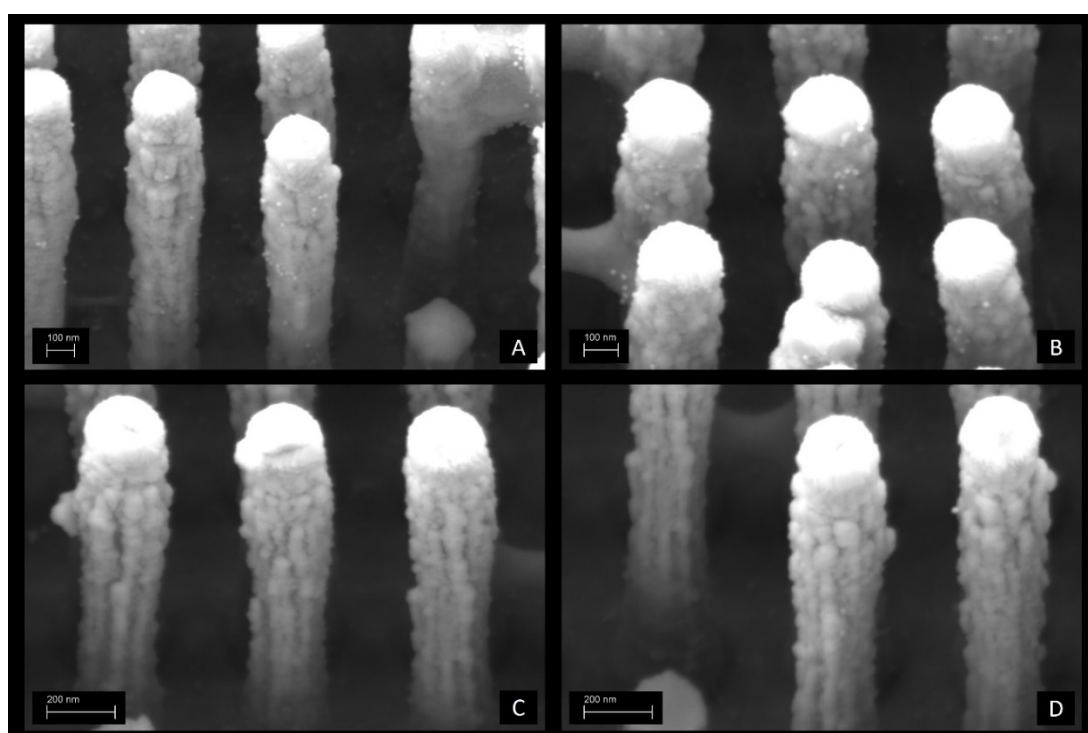

Figure S6. SEM imaging of arrays of R-NPs/ITO after Au-NPs deposition (**A**, **B**) and negative control (**C**, **D**) of biological detection experiment.