Detection of the Early Stage of Recombinational DNA Repair by Silicon Nanowire Transistors

Marco Chiesa[1], Paula P. Cardenas[2], Francisco Otón[3], Javier Martinez[1], Marta Mas-Torrent[3], Fernando Garcia[1], Juan C. Alonso[2], Concepció Rovira[3] and Ricardo Garcia[1,*]

[1]Instituto de Microelectrónica de Madrid (IMM-CNM-CSIC), Isaac Newton 8, 28760 Tres Cantos, Madrid, Spain,
[2]Centro Nacional de Biotecnología (CNB-CSIC), Darwin 3, 28049 Madrid, Spain,
[3]Institut de Ciència de Materials de Barcelona (ICMAB-CSIC) and CIBER-BBN, Campus Universitari de Bellaterra, Cerdanyola, 08193 Barcelona, Spain.
mchiesa@imm.cnm.csic.es *ricardo.garcia@imm.cnm.csic.es

A silicon nanowire-based biosensor has been designed and applied for label-free and ultrasensitive detection of the early stage of recombinational DNA repair by RecA protein.[1] Silicon nanowires transistors were fabricated by atomic force microscopy nanolithography and integrated into a microfluidic environment.[2] The sensor operates by measuring the changes in the resistance of the nanowire as the biomolecular reactions proceed. We show that the nanoelectronic sensor can detect and differentiate several steps in the binding of RecA to a single stranded DNA filament taking place on the nanowire-aqueous interface. We report relative changes in the resistance of 3.5% which are related to the interaction of 250 RecA·single stranded DNA complexes. Spectroscopy data confirm the presence of the protein-DNA complexes on the functionalized silicon surfaces.

References

[1] Carrasco, B.; Manfredi, C.; Ayora, S.; Alonso, J. C. DNA Repair **7** (2008) 990.
[2] Martinez, J.; Martinez, R. V.; Garcia, R. Nano Lett. **8** (2008) 3636.

Figures

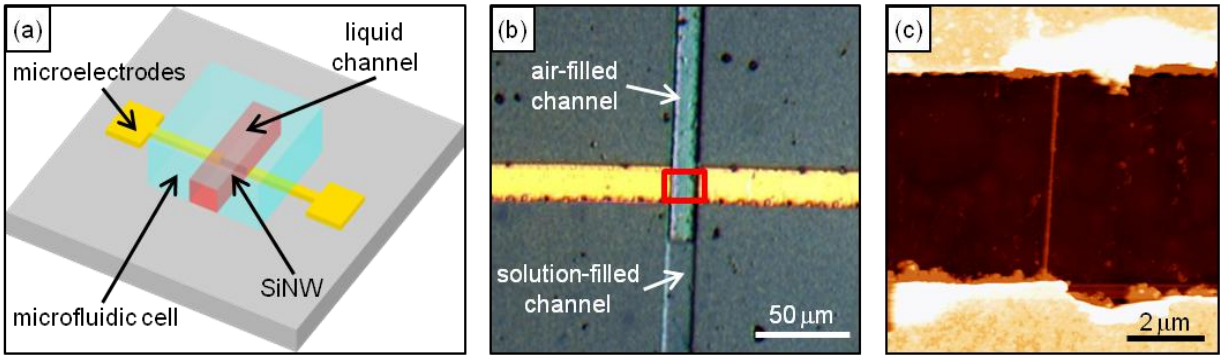

Fig. 1: (a) Scheme of the device set-up that includes the microfluidic cell. (b) Optical micrograph of the microfluidic channel, gold micro-contacts and nanowire region that bridges the Au contacts. The change in contrast in the channel indicates the regions filled (dark) or unfilled (bright) with the protein solution. (c) AFM image of the device active area (red rectangle of (b)) taken after several biosensing measurements.

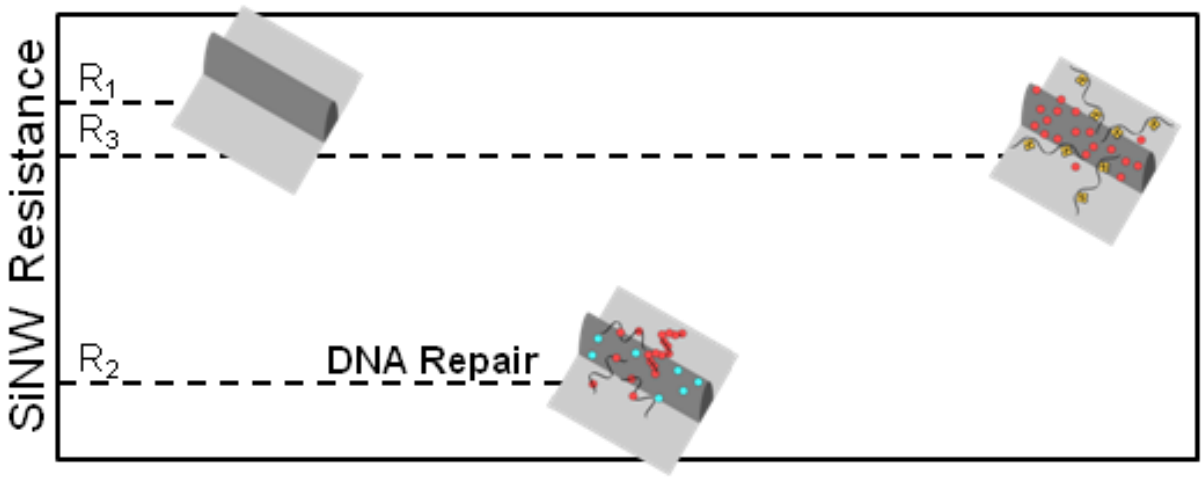

Fig. 2: Principle of the biosensor. When the nanowire is covered by a solution with RecA filaments over ssDNA, the resistance reaches a minimum. When a protein impeding the formation of filaments, SsbA, is added to the solution, the resistance of the nanowire partially recovers.