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Self-powered, self-sustained and self-indicated biosensors for cancer biomarkers

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Biosensors are an expanding field of (nano)technology. The most successful commercial biosensor within time remains the glucose meter, combining an electrical reading box with a glucose strip, which is indeed an electrochemical biosensor. The great success of this approach has attracted the attention of researchers over time, driven to explore and develop other electrochemical biosensors, sensitive to other biomolecules of interest in many fields in which cancer biomarker detection is of particular interest.

In brief, electrochemical biosensors combine in a single device a (bio)recognition element (a) and an electrical transducing element (b). The biorecognition element (a) is the one responsible for the selectivity of the biosensor (its ability to discriminate a target compound among several others). There are many (bio)recognition elements that may be used for this purpose. Among these, molecularly imprinted materials mimicking the behavior of antibodies have been shown a suitable choice. The transducing element (b) is responsible to translate the electrical changes generated by the localized interaction between the (bio)recognition element and the target compound into a measurable event.

The basic requirements of electrochemical biosensors include electrical and electronic dependency. Avoiding these requirements would shift these into a new generation of biosensors. For this purpose, it would be necessary to have an autonomous electrical power, to support electrical autonomy. This could be achieved by merging biosensing technology (i) and photovoltaics (ii) into a single device. In turn, avoiding electronics requires a self-signaled event. As the electrical power generated by the merged biosensor/photovoltaic cell shall be concentration dependent, an electrochromic cell (iii) could lead to a colored signal visible by naked eye.

Such innovative and disruptive approach is described herein and has been proven successful for the detection of cancer biomarkers, namely carcinoembryonic antigen (CEA), and cancer antigen 15-3 (CA 15-3). Overall, this new approach opens new doors towards a completely new concept of biosensing, with application all areas where biosensing becomes necessary.

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