3. Biofuel cells

The emergence of the topic “biofuel cells” is driven by the need for clean methods of producing electricity from renewable fuel sources and the ever-increasing depletion of fossil fuels. Biofuel cells that convert chemical energy into electrical energy by the catalytic reaction of enzymes or living organisms, are the subject of intensive research due to the vast potential applications.

The design of biofuel cells mainly involves the application of redox-enzymes for the targeted oxidation of specific fuel (sugars, alcohols, hydrogen) at the anode and the reduction of oxidizer substrates (O_2, H_2O_2) at the cathode to generate an electrical power output. Since enzymes present very high activity and are highly selective, the design of biofuel cells does not require a separation between bioanode and biocathode. The performance of biofuel cells is characterized by its power output and open circuit voltage.

The challenge is to design devices whose power and size will be compatible with a use as portable source of energy (miniature generators of low power for mobile phone or GPS). Associated to conventional batteries, these biosystems will be able to also ensure a recharging of the batteries and a standby mode for electronic equipments.

The majority of these biofuel cells produces electric power from the electro-enzymatic degradation of glucose and O_2, two substrates present in physiological fluids. Therefore, the main motivation for the development of the biofuel cells concerns their use in the human body as autonomous source of energy for implanted medical devices.

Powering future generations of implanted medical devices will require cumbersome transcutaneous energy transfer or harvesting energy from the human body. Since no functional solution that harvests power from the body is currently available, glucose biofuel cells look very promising as a source of power for implanted devices.