

Introduction

Modified electrodes functionalized with various organic monolayers and thin films attached to conducting surfaces have found numerous applications in electrocatalysis, sensors, and fuel cells [1–7]. Particularly, active research has been directed to the applications of modified electrodes in different bioelectrochemical systems [8, 9], including biosensors [10–13] and biofuel cells [14–17]. In the past two decades, different modified electrodes functionalized with signal-responsive molecules [18], polymers [19], or supra-molecular complexes [20] were developed to facilitate the “switch-on-demand” electrochemical properties of the electrode surfaces. Their applications in switchable biosensors [21], fuel cells [22], and electrochemical systems processing information [23] have been suggested. Various physical or/and chemical signals as well as their combinations were used to switch electrochemical properties of the modified interfaces between active and inactive states for specific electrochemical, electrocatalytic, and bioelectrocatalytic reactions. Light signals (irradiation of electrodes with visible or ultraviolet light) [24–31], magnetic field applied at electrode surfaces loaded with magnetic nanoparticles or magnetic nanowires [32–43], and electrical potentials producing chemical changes at the electrode surfaces [44–48] were used to reversibly alternate electrochemical properties of the modified electrodes. Chemical [29, 49–51] or biochemical [52] signals resulting in reversible changes of the interfacial properties were also used to switch the electrode activity ON/OFF for specific electrochemical transformations. Particularly, important progress has been achieved in switchable bioelectronics, where signal-controlled electrodes have been used for adaptable features of novel bioelectronic devices [53]. This book gives an overview of the different signal-responsive electrochemical interfaces and complex multicomponent electrochemical systems, particularly emphasizing the importance of scaling-up the complexity of the signal-processing systems.

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