WIRELESS ELECTROCHEMISTRY: From Advanced Materials to (Bio)electroanalysis and Enantioselective Synthesis

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Wireless electrochemistry, more scientifically also called bipolar electrochemistry, is a concept based on the fact that two opposite chemical processes, oxidation and reduction, occur simultaneously on the surface of a (semi)conducting object, without connection to a power supply [1]. We distinguish between exogenous bipolar systems, for which the primary driving force originates from an external electric field, and endogenous bipolar objects, where an asymmetric chemical composition provides the necessary thermodynamic power to induce spatially separated reactions [2]. The basic phenomena have already been described and used for a long time, but regained interest in recent years, because it became apparent that bipolar electrochemistry has attractive features for developing new applications in various areas. This is mostly due to several advantages over classic electrochemistry, such as the absence of an ohmic contact, the generation of a dual gradient of electroactivity on the same object and the possibility to address simultaneously thousands of objects. Also, some features of this type of electrochemistry allow performing experiments which simply cannot be done with a classic electrochemical set-up.
The objective of this presentation is to introduce first the basic aspects of bipolar electrochemistry, and then to illustrate some very recent applications of this concept studied in our group, ranging from materials science [3–6] and (bio)electroanalysis [7–10], to the generation of motion [11–16] and electrosynthesis [17,18], also of chiral molecules, thus opening interesting perspectives for the pharmaceutical industry [19,20].

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