Advanced voltammetric techniques derived from square-wave voltammetry for mechanistic and kinetic study of electrode processes

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This lecture presents the development of innovative electroanalytical techniques designed to enhance applications in modern electroanalytical chemistry. After a brief overview of the fundamental principles of electrochemical experiments and the key factors influencing analytical sensitivity, several novel methodologies are introduced, with particular emphasis on square-wave voltammetry (SWV). Two new variants—double-sampled differential SWV [1] and multi-sampled SWV [2] are described, both based on an advanced current sampling strategy. This approach is further extended by transforming SWV into a pulse-based chronoamperometric format, resulting in square-wave chronoamperometry [3], which is a versatile technique that enables multi-frequency [4] and multi-amplitude [5] analysis of electrode processes within a single experiment. Additionally, a new pulse-voltammetric technique is proposed, integrating features of both differential pulse voltammetry and SWV [6]. Theoretical analysis of various electrode mechanisms is performed using these methods, facilitating the selection of the most appropriate technique based on analytical performance and the capacity for rapid kinetic and mechanistic characterization. Experimental results from model systems are presented in support of the theoretical findings.

References

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