Recent Advances in Materials and Technologies for Sensing Janus Kinase Inhibitors in Biomedical Systems

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Abstract:
Janus kinase inhibitors (JAKis) represent a relatively new class of drugs approved for the treatment of inflammatory and autoimmune diseases by blocking Janus kinase (JAK) enzymes. Monitoring precise drug concentration ensures therapeutic effect while minimizing the risk of toxicity. In parallel to a key reference method, liquid chromatography-mass spectrometry (LC-MS), sensitive electrochemical methods for the detection of JAKis have been developed in very recent years. The objective of the work is to address both current trends and future potential in the development of novel electrochemical sensors and procedures for the JAK inhibitors detection directed to a real-time point-of-care analysis enabling personalized therapeutic drug monitoring.

The results obtained at the electrochemical detection of JAKis such as baricitinib, ruxolitinib, tofacitinib, and upadacitinib demonstrate successful utilization of conventional bare electrode materials and, particularly, chemically modified electrodes incorporating nanomaterials and their composites as powerful catalysts as well as imprinted polymers. Procedures of sensors preparation and use are presented for achieving extraordinarily low detection limits in pharmaceutical and biological matrices and, in some cases, with the performance approaching that of LC–MS-based assays. At the present state, the linear concentration ranges and limits of detection achieve very low 10^{-9} M to 10^{-12} M (ng to pg/mL) values, matching clinically relevant drug levels.

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