Single-walled carbon nanotubes for enantioanalysis of malic acid in wines

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Single-walled carbon nanotubes (7,6) chirality were used for the design of multimode electrochemical sensors using different carbon matrices such as graphene paste, graphite paste, and carbon nanopowder paste. L- and D-malic acids were used as model analytes. The responses of the multimode sensors were evaluated for the potentiometric and differential pulse voltammetry (DPV) modes. The results obtained showed that the matrix can influence the enantioselectivity of the chiral single-walled carbon nanotubes. When carbon nanopowder was used as matrix, the multimode sensor was enantioselective for D-malic acid on the ranges: 10^{-3} – 10^{-6}, and 10^{-11} – 10^{-15}mol/L for the potentiometric mode, and 10^{-5} – 10^{-8}mol/L for the DPV mode. The graphite paste based sensor was enantioselective for L-malic acid on the ranges: 10^{-10} – 10^{-13} for the potentiometric mode and 10^{-4} – 10^{-7}mol/L for the DPV mode. The sensors based on graphene and chiral single-walled carbon nanotubes were enantioselective for D-malic acid, and a response was obtained only on the DPV mode. Accordingly, the matrix influenced both the enantioselectivity and the sensitivity of the measurements. The application of the sensors was for the enantioanalysis of malic acid in wine samples. The proposed method is fast, and reliable, and allow the quantification of L- and D-malic acids using electrochemical methods based on different principles, directly from the real sample.

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