

ABSTRACT

New possibilities in collection of polarographic and potentiometric experimental data in studies of metal–ligand systems by automated instrumental methods, and subsequent treatment of the polarographic data, whereby the degree of reversibility of the electrode processes varies, have been investigated in this work. An automated instrumental set–up was developed for applications in studies of metal–ligand solution equilibria by potentiometry and sampled Direct Current Polarography (DCP). The new set–up was designed based on virtual instrumentation principles whereby several commercially–available hardware units as well as custom–built electronic components, were interfaced to a personal computer that was equipped with appropriate hardware and control programs. The instrumental set–up was tested and validated by studying the protonation equilibria of the ligand glycine by Glass Electrode Potentiometry (GEP) as well as the complexation of the ligand glycine with Cd^{2+} by GEP and DCP. The new set–up provides increased versatility, accuracy and convenience in obtaining large numbers of experimental points in solution equilibria studies by DCP and GEP as opposed to the use of tedious and time–consuming manual methods. Nonlinear curve–fitting procedures, based on closed–form models that were derived here from suitable theoretical equations identified from literature, have been investigated in this work for applications in analysis of DC curves recorded on metal–ligand systems with variation in electrochemical reversibility. The applicability and limitations of the curve–fitting procedures developed have been tested in analysis of the DCP data collected on several metal–ligand systems involving Cd^{2+} , Pb^{2+} , Zn^{2+} and the ligands glycine and sarcosine, whereby the DCP studies of these systems exhibited reversible, quasi–reversible or irreversible electrochemical processes. Information on applicability and limitations of the proposed methods investigated in this work was derived by comparison of the results obtained from DCP, using the proposed methods, with either reported literature data and/or results obtained in this work by the independent analytical technique of GEP, which was deployed wherever it was found to be applicable to study the metal–ligand systems considered.