Solvent-Processible Polymer Membrane-Based Reference Electrodes for Miniature Chemical Sensors

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We have recently developed a new type of liquid junction-free reference electrode that is suited for fabrication of miniature ion sensor devices[1]. The proposed reference electrode system employs a solvent-processible polymer membrane, and the best performance membrane so far is formulated with an aromatic type polyurethane, synthesized with 4,4'-methylenebis(phenyl isocyanate) and poly(tetramethylene ether glycol). The optimized formulation incorporates both cation and anion exchanger sites (i.e., potassium tetrakis(p-chlorophenyl)borate and tridodecylmethylammonium chloride). Such an optimized membrane is shown to exhibit only a small emf variation (within ±2 mV) toward a wide variety of salts added even at very high concentrations (i.e., up to 0.1 M). Furthermore, the membrane is not sensitive to pH over a wide pH range (i.e., pH 2-12) unlike most other polymer matrix membranes. Potentiometric emf responses of ISEs (e.g., Na^+, K^+, Ca^{2+}, Cl^-), whether paired with a polymer membrane-based reference electrode or with a conventional liquid junction-type reference electrode, are shown to be remarkably similar within the precision of the measurement setup. In this presentation, we will also demonstrate the integration of miniaturized ISEs with a solvent-processible polymer-based reference electrode. The ISEs (i.e., Na^+, K^+, Ca^{2+}, Cl^- and pH) and reference electrode are integrated on the same substrate (either alumina plate or silicon wafer). Potentiometric responses between each ISE and the polymer membrane-based reference electrode, to control and serum samples, are measured in a flow-through arrangement. The analytical results for each electrolyte are shown to be in excellent agreement with those obtained with a standard desktop clinical analyzer.

References

1 Lee H. J., Hong U. S., Lee D. K., Shin J. H., Nam H., Cha G. S.. Anal. Chem., 1998, **70**:3377