1.5 Immunosensor Systems with Renewable Sensing Surfaces

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Abstract. A complication emerges when antigens and antibodies interact in continuous-use immunosensor systems. This complication comprises the regeneration of the biological sensing surface. In the present work we report the development and the study of two strategies designed to overcome this limitation.

The first strategy is based on the construction of amperometric immunosensors using rigid immunocomposites. These materials contain a conducting polymer composite that acts as a support for the bulk-immobilized immunological material. The surface of these immunosensors is renewable. A simple polishing procedure uncovers a fresh immunocomposite surface ready for a new immunoassay. This contrasts with conventional, single-use devices. Furthermore, immunosensors of different sizes and shapes can be produced using these immunocomposites. The closeness between the immunoconjugate enzyme-label and the conducting sites on the surface of the sensor yields a higher electron transfer efficiency. This is clearly convenient when building amperometric devices. The simplicity of this strategy makes it particularly convenient for manual immunoassay methodologies.

The second strategy is based on an immunochemical analysis system featuring flow injection techniques. This system uses potentiometric detection with immunochemical reagents immobilized on magnetic particles where the sensing surface can be renewed after each analysis. Measurements are reproducible since the
magnetic particles can be fixed to the surface of the sensor at will. The regeneration of
the sensing surface is achieved by turning on or off a magnetic field. This is especially
difficult or cumbersome. The simplicity and flexibility of this strategy makes it
particularly convenient for automated immunoassay methodologies. It is also versatile
because a wide choice of immunological reagents can be used.

These two immunosensor systems were applied to the measurement of RlG using a competitive technique. They were also used in the detection of GaRlG using a sandwich technique, where peroxidase was the enzyme label for amperometric measurements and urease the label for potentiometric measurements.

1.5.1 Introduction

Immunoassay techniques are becoming increasingly important in the clinical field
(Owen 1994, Blanchard et al. 1990, Heinemann and Halsall 1985) for determination
of drugs (Blake and Gould 1984, Wang 1988), metabolites, steroids and hormones
(Duan and Meyerhoff 1994). At present, environmental applications of these analytical
techniques are spreading (Blanchard et al. 1990, Nelson et al. 1995, Marco et al.
1995), to analyze pollutants such as pesticides (Hammock et al. 1980, Kindervater et
industrial waste materials (Blanchard et al. 1990) and degradation products.

Heterogeneous immunoassay techniques require a solid phase with immobilized
immunoreagents. This configuration allows the separation of the free immunoreagent
and the bound immunoconjugate after a wash cycle.

Several techniques for the immobilization of the immunological material have
been described (Hall 1990). These techniques include the immobilization of the
immunoreagent on different polymer surfaces and activated membranes (Glazier and
Rechnitz 1991, Sansubrino and Mascini 1994), capillary tubes (Rogers et al. 1991),