Synthesis and Electrochemical Properties of Poly(aniline boronic acid): A Novel Transduction Method for a Non-enzymatic Glucose Sensor and A Precursor Route to Substituted Polyanilines

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In this presentation, we describe the electrochemical production, properties, and application of poly(aniline boronic acid)(PABA). The discussion will focus on two topics: A novel strategy for 1) sensing glucose (sugars) on the basis of a non-enzymatic approach [1] and 2) preparing a wide range of substituted polyanilines by a novel electrochemical method [2].

The use of conjugated polymers for sensor applications continues to be the subject of intense research [3]. In addition to their use as electronic conductors, they have been exploited as active sensing elements by coupling ligands to the backbone. In the latter approach, binding of an analyte results in physical distortions or changes in electron density thereby altering conductivity [3]. Polyaniline, in particular, has received a great deal of attention due to its proton coupled redox chemistry and its resulting pH dependant properties [4]. Substituted polyanilines [1,5] are also of great interest for a variety of applications ranging from electronics to sensors.

We have been examining a new strategy that exploits the inductive and resonant effect of reactive substituents on the pKa of polyaniline to produce active sensing elements [1]. Boronic acid-based sensors [6,7] provide an attractive alternative enzyme-based sensors [8,9] since the complexation is a reversible, equilibrium-based reaction (*i.e.*, the analyte is not consumed). To examine this alternative approach, we have focused on the electrochemical transduction induced by glucose binding that results in a change in the electrochemical potential associated with the change in pKa of the boronic acid groups in PABA. Promising results were obtained.

In addition to sensing applications, boronic acids provide versatile chemical reactivity that allows it to be converted into a wide range of substituent groups [2]. Examples include, but not limited to, the conversion to hydroxyl [10], halogen [11], and nitro [12] groups under mild conditions. In these particular examples, a boron activation-electrophilic displacement mechanism resulting in ipso-substitution is proposed. Thus, we have examined the conversion of PABA to other polyaniline derivatives using this approach. Our novel precursor route, in fact, allows the production of polyaniline derivatives that have not been made previously due to complicating side reactions. This new electrochemical method has the capability to manipulate the reaction conditions as well as to allow chemical reaction control. With a careful control of electrochemical and reaction conditions, the production of poly(hydroxy aniline) and poly(halo aniline)s was successful. The electrochemical properties of these polymers will be discussed in detail.

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