

Electrode reactions of elemental (white) phosphorus and phosphane PH₃

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Abstract

Electrochemical methods have become important from the viewpoint of the development and creation of new ecologically safe and resource-saving chemical processes. The use of electrons as a "universal" and "inexhaustible" reagent for chemical reactions is the main advantage of electrochemical tools. Although electrochemical processes have been already successfully applied in the preparation of different classes of practically important chemical compounds, a very limited number of industrially applicable electrochemical processes that involve elemental (white) phosphorus is currently known, except for some examples of the electrochemical production of phosphane PH₃. These are mainly associated with the investigation of bulk reactions of the electrochemically activated P₄ molecule and phosphorus intermediates derived therefrom; very limited attention has been paid to the electrode surface reactions as a key stage of the electrochemical process. In this Microreview we describe the electrode reactions of elemental (white) phosphorus and phosphane that accompany the electrochemical process of the preparation of some phosphorus compounds starting directly from P₄. The important role of the nature of the electrode material, the reactivity of the formed phosphorus intermediates and the surface processes are discussed. Moreover, recently, we succeeded in discovering a new, previously unstable phosphorus compound, phosphane oxide H₃PO, which can be easily produced using an electrochemical method by mild anodic oxidation of phosphane PH₃ electrochemically formed from P₄. In this respect, some attention has been paid to the electrochemically induced processes of PH₃ oxidation that result in the selective formation of phosphane oxide, which is of high interest from the viewpoint of the investigation of its properties and reactivity. Electrochemical processes involving elemental (white) phosphorus (P₄) and phosphane (PH₃) have been investigated and described. The importance of surface processes and the role of the electrode material in the electrochemical reactions have been elucidated. The electrochemical oxidation of PH₃ and the generation of unstable H₃PO using sacrificial metal anodes are discussed. Copyright © 2013 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim.

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Keywords

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