POLYANILINE ELECTRICAL SYNTHESIS AND ITS APPLICATION IN CHEMICAL POWER SOURCES

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Abstract

Many works have been dedicated to polyaniline (PA) application in chemical power sources (ChPS), for instance, the Zn -PA, Li – PA systems in their various configurations have been studied [1-3] and it has been shown that the optimization of electrochemical synthesis conditions and subsequent polyaniline electrode special processing provide the production of ChPS with high specific features.
Potential PA applications in ChPS depend on the stability of its properties. Different factors affect PA properties both at its synthetic stage and by its subsequent utilization. Potential mechanism of PA initial and subsequent polymerizations has been considered using potentiodynamic, cyclic, and galvanostatic synthesis techniques.

It is shown that anion and monomer molecule radicalization on anode:

$$\text{a)}\quad A^- \xleftarrow{-e} A^\bullet$$

$$A^\bullet + B\text{-}NH_2 \longleftrightarrow [\,B\text{-}NH_2\,]^{\bullet+} + A^-$$

$$\text{b)}\quad B\text{-}NH_2 \xleftarrow{-e} [\,B\text{-}NH_2\,]^{\bullet+} \xleftarrow{-H^+} Q{=}NH$$

is an important factor for aniline molecule dimerization:

$$\text{a)}\quad [\,B\text{-}NH_2\,]^{\bullet+} + [\,B\text{-}NH_2\,]^{\bullet+} \xrightarrow{-H^+} B\text{-}NH\text{-}B\text{-}NH_2$$

$$\text{b)}\quad [\,B\text{-}NH_2\,]^{\bullet+} + Q{=}NH \xrightarrow{-H^+} B\text{-}NH\text{-}B\text{-}NH_2$$

Such aniline dimer represents leucoemeraldin, but with potentials more positive than 0.8 V, it promptly reduces to emeraldine and pernigraniline:

$$B\text{-}NH\text{-}B\text{-}NH_2 \xrightarrow{-2e} B\text{-}NH\overset{\bullet}{\text{-}}B\text{-}NH\overset{\bullet}{} \xleftrightarrow{H^+\ H^+} B\text{-}NH{=}\,Q\,{=}\,NH \xleftrightarrow{H^+\ H^+\ -2H^+} B\text{–}N{=}Q{=}NH$$

Radicalized anions by their interaction with dimer (or polymer) generate salt, which facilitates benzoid-chinoid interaction and radicalized monomer addition without electric

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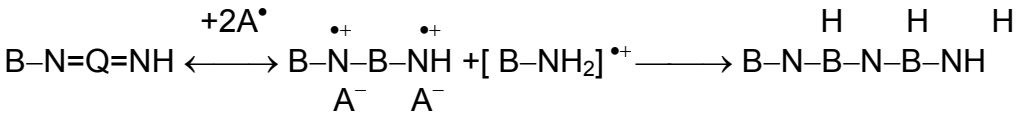
charge losses.



The proposed polymerization mechanism [5] provides feasible explanation of potentiodynamic curve shapes and cyclic voltamperometric figures, as well as self-catalytic nature of PA synthesis.
The production technologies [4,6,7] for film polyaniline on an electric conductive carrier and for powdered PA have been developed, and its trial as cathode active agent in various-design ChPSs has been conducted. Secondary tablet- or roll-shaped ChPSs are found very promising for Li / PA or Li-Al/ PA systems with proton-free electrolyte, which confirms the efficiency of our chosen approach to the development of polyaniline cells.

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