PROTONIC CONDUCTIVITY OF POLYANTIMONIC ACID BASED ELECTROLYTES IN A RANGE 20-250 °C

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The development of the scientific basics for the novel membrane materials manufacturing for electrochemical power units i.e. low temperature fuel cells (FC) efficiently working up to 300 °C is a serious scientific problem related to hydrogen energy shift. Polyantimonic acid (PAA) is characterized by high conductivity and thermal stability can be regarded as a prospective proton conducting material. So the goal of the current work was the investigation of the structure, phase stability, and protonic conductivity of PAA based solid electrolytes.

PAA was synthesized using the controlled hydrolysis of $SbCl_5$ in the tenfold excess of water. Then the precipitate was treated by 1n HCl and again washed with distilled water until the negative reaction to clorine ions. Then using 10 and 20 wt.% of fluoroplastic as a binder the cylindrical solid electrolytes (SE) of 30 mm in diameter and 5 mm in thickness were formed by cold uniaxial pressing. Structure of the formed membranes was investigated by thermo-XRD (SHIMADZU XRD-6000), SEM and EDX (Hitachi S-3400N) techniques, STA technique, Raman spectroscopy and hydrostatic weighting. The conductivity of SE in the range 60-300 °C was investigated by electrochemical impedance study in the dry nitrogen, room air and presence of humidity.

Using STA and XRD it was shown that the structure of SE correspond to crystalline $Sb_2O_5 \times 3H_2O$. STA, Raman spectroscopy and thermo-XRD showed that the temperature increase results unit cell shrinkage and crystallinity decrease from ~91 to 75% because of step by step water removal. According hydrostatic weighting, SEM and EDX data, fully dense membranes were obtained, where a binder do not cover PAA grains enabling the ion transport though the grain bulk. Via impedance spectroscopy it was shown that PAA is a great protonic conductor in a presence of moisture. The temperature dependence of conductivity of PAA is complex due to prolonged water losses and the increase of carrier charge mobility with temperature increase.

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