Spectroscopic characterization of electrodeposited silicon based films photoactive in water solution

Agata Krywko-Cendrowska[a], Laurent Marot[b], Marcin Strawski[a], Roland Steiner[b], Ernst Meyer [b], Marek Szklarczyk[a1]

[a]*Laboratory of Electrochemistry, Faculty of Chemistry, University of Warsaw, ul. Pasteura 1, 02-093Warsaw, Poland*
[b]*Department of Physics, University of Basel, Klingelbergstrasse 82, CH-4056 Basel, Switzerland*

Silicon is one of the most significant elements to be applied in industry, it is useful in aluminum production (about 60% of silicon consumption), as an addition to steel and in electronic industry. The present main source of electronic silicon is reduction of silica by carbon at ca. 1900^{o}C, followed by an application of a purification method. Toxic waste formed during these processes is another disadvantage of a standard way of the production of silicon. Therefore, the overall process of silicon production is extremely energy consuming and highly toxic and thereby-environmentally hazardous.

The methods of silicon electrodeposition might be considered as a low energy consuming processes and a low cost alternative for the standard high temperature methods. The advantages of these electrochemical methods are; possibility of a precise control during the electrically driven process, the growth in temperatures below melting point, the solvents can dissolve oxide impurities, purification occurs during electrodeposition because of differences in deposition potential between major and minor components. Electrolysis might be convenient for epitaxial deposition of silicon since the growth occurs uniformly over the sample area.

The interests in the possibility of silicon electrodeposition started in the mid 1800's with the work of H. St.Claire De Ville [1]. It was a high temperature electrodeposition from molten $NaAlCl_4$ but his material did not oxidize so such a claim might be questionable. C. Gore claimed that he deposited silicon at a low temperature from water solution of K_2SiO_2 [2] which has never been confirmed. F. Ulik was probably the first to deposit elemental silicon by an electrochemical method from molten solution of K_2SiF_6 and KF [3]. H.N. Warren deposited silicon under low temperature conditions and showed suitability of halides and organic solvents in the process [4]. The serious problems coupled with electrodeposition of silicon films have been reported [5-11].

In this presentation we report results on silicon based films electrodepositon from 0.1 M *tert*-buthyl ammonium bromide (TBAB), dissolved in propylene carbonate (PC). We show reproducible and stable photoactivity of films in water solution. These films were produced by potentiostatic method in the potential range from -2,0 V to -2,85 V vs. Ag wire. Photoactivity was tested in PC and water solution and a maximum photoactivity in the dependence on electrodeposition potential and deposition charge was found. To explain these observations produced films were characterized by FTIR and XPS techniques. The obtained results show that photoactivity and stability of this effect increase with the concentration of SiO monoxide in a silicon based film.

The morphology and thickness of produced films were determined by scratching Atomic Force Microscopy (AFM) technique [12]. Depending on the electrodeposition potential, the obtained thickness varied from 1 μm to ca. 6 μm.

[1] Presenting author: e-mail address szklarcz@chem.uw.edu.pl, tel.: 48-22-822-0211

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