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Electrodeposition of Silicon from Fluorosilicic Acid Produced in Iraqi Phosphate Fertilizer Plant

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ABSTRACT:

The availability, low toxicity, and high degree of technological development make silicon the most likely material to be used in solar cells, the cost of solar cells depends entirely on cost of high purity silicon production. The present work was conducted to electrodeposite of silicon from K_2SiF_6 , an inexpensive raw material prepared from fluorosilicic acid (H_2SiF_6) produced in Iraqi Fertilizer plants, and using inexpensive graphite material as cathode electrode. The preparation of potassium fluorosilicate was performed at (60°C) in a three necks flask provided with a stirrer ,while the electro deposition was performed at 750°C in a three-electrodes configuration with melt containing in graphite pot. High purity potassium fluorosilicate (99.25%) was obtained at temperature (60°C), molar ratio-KCl/H₂SiF₆(1.4) and agitation (600 rpm). Spongy compact deposits were obtained for silicon with purity not less than (99.97%) at cathode potential (-0.8 V vs. Pt), K_2SiF_6 concentration (14% mole percent) with grain size (130 µm) and level of impurities (Cu, Fe and Ni) less than (0.02%).

Keywords : Silicon, Potassium fluorosilicate, Flourosilicic acid, Electrodeposition, Molten salt

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1. Introduction

Silicon is an important material in modern semiconductor technology and finding increased use in solar cells for photovoltaic generation of electricity. High-efficiency solar energy conversion has long been the subject of intense attention because this process is environmentally friendly and does not disturb the thermal balance of the planet. The cost of raw material-high purity silicon is to about 20% of the cost of silicon solar modules. To make solar cells less expensive, it is necessary to reduce either the cost of the raw material or the silicon consumption in the fabrication of solar cells. In light of this, reducing the cost of silicon for solar cell continued to be a challenge.¹⁾

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In recent years there has been considerable interest in the electrodeposition of silicon from molten salts, the major reason is the highly purity of crystals prepared for photovoltaic application.²⁾ Progress in silicon electrodeposition and possible application of the electrolytic silicon has been reviewed by a number of authors.^{3,4,5,6)} The preparation of high purity silicon could be achieved either by Silicabased or fluorosilicate-based electrolytes . The electrodeposition of silicon from silica-based electrolyte has been reviewed by Monnier.7) The melt compositions most likely to serve as electrolytic bathes are molten silicates or solutions of SiO₂ in cryolite at temperature (1370-1450°C). In addition to high temperature, the high purity silicon required the use of a tow-stage cell. Electrowining occurred in the first stage, the cathode of which formed the anode of the second stage.

The electro deposition of silicon from solution of K2SiF6