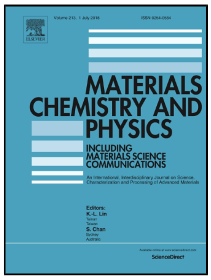
Accepted Manuscript



Production of high throughput nano-porous silicon (NPS) powder with different architectures

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PII: S0254-0584(18)30453-X

DOI: 10.1016/j.matchemphys.2018.05.048

Reference: MAC 20663

To appear in: *Materials Chemistry and Physics*

Received Date: 01 August 2017

Accepted Date: 21 May 2018

Production of high throughput nano-porous silicon (NPS) powder with different architectures

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Abstract

In this study, a powder technology manufacturing route as a pioneering, low cost, simple and safe method is used for the fabrication of nano-porous silicon (NPS) powder. It is a promising one as its high throughput for different applications due to their supposed low toxicity and good compatibility. The NPS has been prepared using a combination between high energy ball milling technique and wet alkali chemical etching based technique through the utilization of commercial silicon powder; with high yield efficiency (86.3%). Preparation of several NPS shapes (nanorods, nanoplates, nanwalls, nanospheres and nanobelts) are fabricated, which could be used in different applications. The most significant reduction of the crystallite size was observed by increasing the milling time. Transformation of crystallographic plane of the commercial powder Si (400) to the NPS {(111), (220), (211), (312) and (400)} is resulted, using several concentrations of (KOH) as the etchant and wetting agent {n-propanol (NPA)}.

Keywords: Nano porous silicon (NPS), Powder technology, Ball milling, Etching.

Introduction

Porous silicon (PS), since its discovery at 1956 by Uhlir [1], has attracted the attention of many experimental and theoretical researches, due to their particular photoluminescence in the visible range and at room temperature [2]. It is considered as the backbone of many modern industries in various fields [3], such as metallurgy, electronics, and Photonics [4]. It could find an application in a large number of domains such as microelectronics, optoelectronics, chemical and biological sensors, and biomedical devices [2]. Their performance depends on the sizes and morphologies of the Si crystals and pores (including the pore wall), as well as on the specific surface area. PS with variously-sized (nano, meso, and micro-sized) pores has been prepared by a large number of techniques, which are commonly used [5]. These techniques include anodic etching, stain etching, hydrothermal erosion and spark plasma sintering [6]. With applying these techniques, it is possible to obtain PS containing a high quantity of chemically bound hydrogen, which could consequently satisfy the needs of the industry [7] . However and from industrial point of view, the major problems which limit these methods are the high quantity of acids used, the looseness of materials in the filtering phase, the large consumed time for the production and the high cost of the equipment used [8]. Therefore, the application of