Annals of the Academy of Romanian Scientists
Series on Science and Technology and Information
Online ISSN **2066- 8562** Volume **13**, Number 1/**2020**

ANALYTICAL MODELLING AND SIMULATION OF THE SELF-LIMITATION PROCESS DURING THE CHEMICAL ETCHING OF THE BORON-DOPED SILICON LAYERS FROM BN SOLID SOURCES FOR MICROMECHANICAL APPLICATIONS

Florin GAISEANU[1]

Abstract. *An analytical model of the boron diffusion in silicon from the solid boron nitride (BN) sources is presented and is applied to simulate the chemical etching rate and the etching time for the achievement of the silicon micromechanical elements within the bulk micromachining technology. It is shown that the diffusion profile obtained under such conditions is a consequence of a diffusion mechanism by electrically charged vacancies within the high concentration region, where the diffusion coefficient is proportional with the diffusion concentration, and by neutral vacancies in the "tail" (intrinsic) region, where the diffusion coefficient does not depends on concentration. Analytical relations were deduced to express the boron diffusion profile in the high-doping region and in the tail (intrinsic) region. Such relations permitted to express in an analytical way the chemical etching rate and the etching time during the chemical etching process used within the bulk micromachining technology to obtain micromechanical elements, particularly silicon membranes, under well controlled technological conditions.*

Keywords: Analytical modeling; boron diffusion in silicon; boron nitride sources: high concentration profile; diffusion tail; etching rate simulation: etching time simulation.

1. Introduction

The bulk micromachining technology is mainly based on the specific property of the highly boron-doped silicon layers, consisting in a drastic reduction of the chemical etching rate of the silicon. Such property allows to fabricate micromechanical elements by chemical etching process of the silicon layers after the application of a selective boron doping technique [1-3]. It was shown that boron-doped silicon layers with doping levels exceeding values of the order of 10^{20} cm^{-3} become effective stop-layers during the chemical etching of silicon in alkaline type solutions (KOH, NaOH, LiOH) [2] or in EDP (ethylene-diamine-pyrocatechol) [1]. A chemical solution based on the tetramethyl ammonium hydroxide (TMAH) with isopropyl alcohol (IPA), showing similar etching properties was also earlier proposed [2]. The boron-doped silicon layers are used as the most convenient etch-stop technique, based on the capability to control not

[1]PhD, Solid State Physics (University of Bucharest), Principal Senior Researcher (Professor), Science and Technology of Information Bucharest (Romania) and Barcelona (Spain) - (e-mail: fgtext@yahoo.es).