BULK AND SURFACE INVESTIGATION OF POROUS SILICON NANOSTRUCTURE (PSN)

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ABSTRACT

Bulk and Surface Investigation of Porous Silicon Nanostructure (PSN)

In this project, the bulk and surface studies of porous silicon nanostructure were carried out by ellipsometry and photoluminescence spectroscopy (PL) in visible region. The spectra of visible luminescence, dependences of refractive index of PS surface layers on porosity were investigated. Investigations on bulk properties of porous silicon (PS) were done by ellipsometry using an ellipsometer with the light source (He-Ne laser) of wavelength 632.8 nm. Less porosity of PS samples correspond to higher refractive index of the surface region. This refractive index is compatible with the He-Ne laser wavelength. Investigations on surface properties of PS were done using photoluminescence spectrometer of 380 nm Xe light source. The PS surface was found to emit visible luminescence at the room temperature. This was the significance that cannot be found in the bulk silicon. The increase and decrease of PL intensity, PL peak position and full width at half maximum (FWHM) in presence of externally applied lateral current is due to the tunneling of electrons from neighboring quantum well to the holes taking part in the radiative combination and supports the assumption of quantum confinement of holes as the origin of PL in porous silicon.

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Microelectronics is probably the most important achievement of our time, comparable with the invention of letterpress in the 16th, the invention of the steam engine in the 18th or the invention of the electricity in the 19th century, respectively. If nowadays one is talking about "scientific revolution", the term microelectronics is inevitable. The technologies associated with the headwords "Internet" and "data highway" wouldn't be conceivable without the invention of the transistor by Bardeen and Brattain. Although the first transistors were realized with germanium, today's microelectronics technology is dominated by exclusively one material: silicon (Si). In fact, some materials have better properties, for instance, gallium arsenide (GaAs), but there are many reasons why silicon is the material of choice:

1. Silicon is the second frequent element on the earth, the accessible part of the earth consists of 27.5% of this element (predominantly as silicon dioxide, SiO_2)
2. Silicon crystal growth technology is the most evolved one regarding purity, crystal defects (i.e. dislocations) and size (the industry is now starting to develop technologies for processing 12 inch wafers, i. e. single crystals with a diameter of a long playing record).