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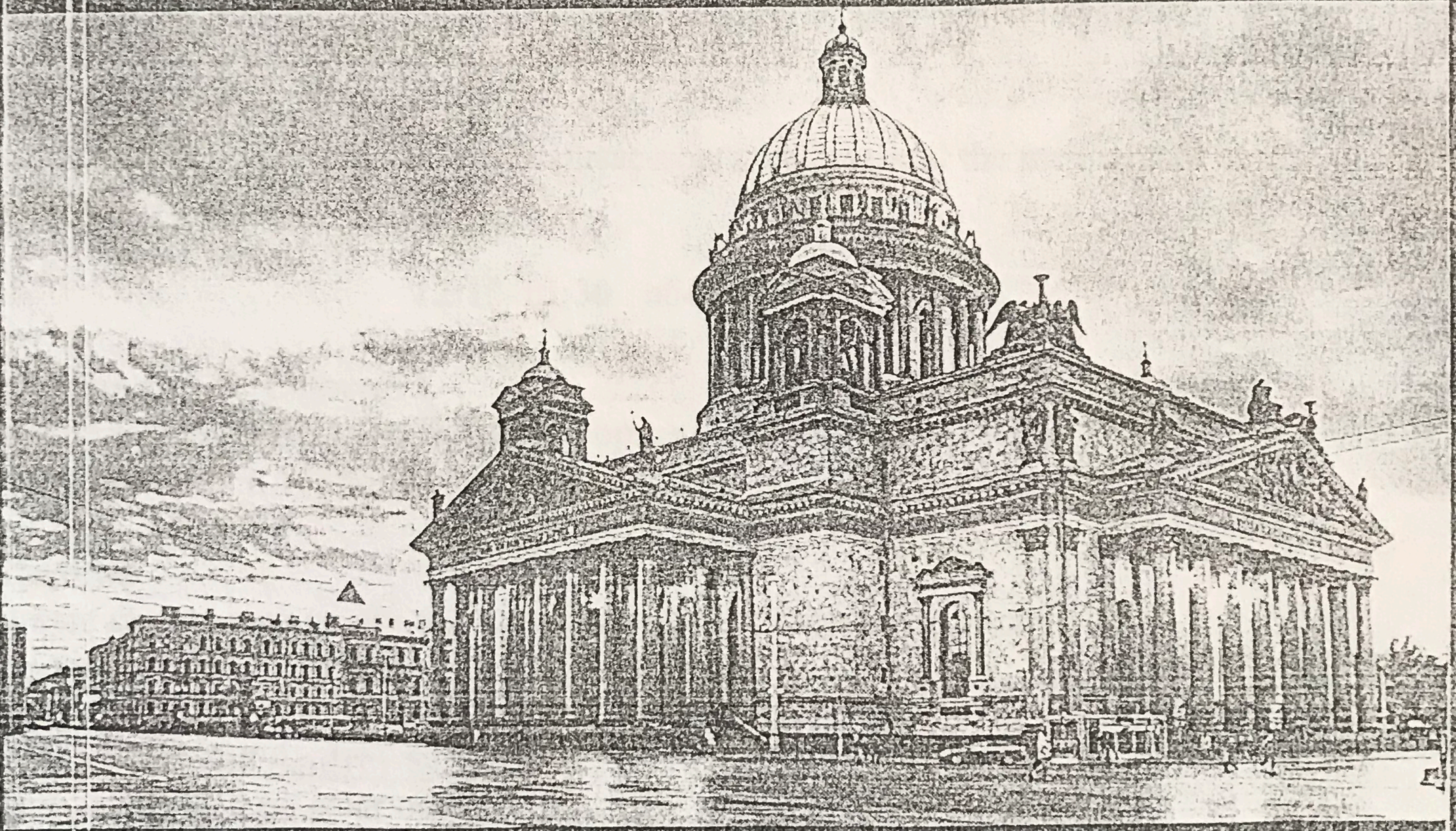
АМОРФНЫЕ И МИКРОКРИСТАЛЛИЧЕСКИЕ ПОЛУПРОВОДНИКИ

Сборник трудов VIII Международной конференции



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2012

Программа VIII Международной конференции «Аморфные и микрокристаллические полупроводники»

2 июля

Пленарное заседание

10:00 Открытие конференции. Председатель оргкомитета **Е.И. Теруков**
Со-председатель оргкомитета **К.Д. Цэндин**

10:05 Коломийцевская лекция. В.И. Иванов- Омский
Наноструктура воды и вода в наноструктурах

10:45 J.O. Oelerich, D.Huemmer, and **S.D. Baranovskii**
How to find out the DOS in disordered organic semiconductors

11:15 А.Г. Казанский
Основные направления и перспективы развития тонкопленочных солнечных элементов

11:45 A.V. Kolobov, P. Fons, J. Tominaga
Local structure of layered Ge-Sb-Te phase-change alloys and the mechanism of phase change

12:15-13:30 обед

13:30 Г.Л. Пахомов, П.А. Стужин
Новые фталоцианиновые материалы в органической электронике: субфталоцианины и тиапорфиразины

14:00 А. Б. Певцов
Фотонные кристаллы на основе халькогенидных стеклообразных полупроводников

14:30 Ehsanollah Fathi and **Andrei Sazonov**
Flexible thin film silicon solar cells

Секция А
Аморфный гидрогенизированный кремний и сплавы на его основе

15:00 A. Kosarev, I. Koudriavtsev, I. Cosme
SIMS characterization of Ge-Si:H films and device structures

15:20 А.П. Авачев, С.П. Вихров, **Н.В. Вишняков**, В.Г. Мишустин
Контактные явления в барьерных структурах металл - неупорядоченный полупроводник

15:40-16:00 кофе

16:00 А.С. Гудовских, К.С. Зеленцов, Д.А. Кудряшов, А.С. Абрамов, Е.И. Теруков

Phase Change Memory: Achievements, Problems and Perspectives

E26. Д.А. Явсин, В.М. Кожевин, С.А. Яковлев, М.А. Яговкина, Б.Т. Мелех, А.Б. Певцов
Получение аморфных пленок $Ge_2Sb_2Te_5$ методом лазерного электродиспергирования

E27. A.P. Odrinski, V.F. Gremenok, E.P. Zaretskaya
Investigation of electrically active defects of $Cu(InGa)(S_{1-y}Se_y)_2$ thin films absorbers

Секция F: Технические приложения

F01. А.В. Медведев, А.Б. Певцов, Д.А. Курдюков, В.Г. Голубев, В.Г. Карпов
Индуцированная электрическим полем нуклеация и эффект переключения в пленках VO2 и композитах опал-VO2

F02. С.С. Карпова, С.В. Мякин, В.А Мошников, Н.Е. Казанцева, А.А. Бобков, К.В. Воронцова
Исследование особенностей адсорбционных центров газочувствительных наноструктур на основе оксидов металлов

F03. A. Smirnov, A. Stsiapanau, E. Mukha, Abubakar Saddiq Mohammed, J.Garcia, A. Hubarevich, J. Solovjov
Sponge like porous silicon formation for integrated electroluminescence light emitting devices

F04. А.А. Шерченков, С.А. Козюхин, **А.В. Бабич**
Исследование кинетики процесса кристаллизации в тонких пленках материалов системы Ge-Sb-Te-Bi

F05. A. Kosarev, A. Torres, I. Cosme, F. Temoltzi
Ge-Si:H films deposited by LF PECVD at low temperatures for device applications

F06. О.Я. Березина, Д.А. Кириенко, Г.Б. Стефанович
Гибкие электронные устройства на основе оксидов переходных металлов

F07. В.М. Лебедев
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F08. Ю.В. Ануфриев, Е.М.Еганова, А.И. Попов, С.М. Сальников
Изучение конструктивно-технологических особенностей современных ячеек PRAM-памяти

F09. В.М. Кашкаров, А.С. Леньшин, П.В. Середин, Б.Л. Агапов, В.Н. Ципенюк
Модификация оптических свойств пористого кремния химической обработкой в ТЭОС

F10. А.Х. Абдуев, А.Ш. Асваров, А.К. Ахмедов, Д.А. Свешникова
Формирование нанопорошков ZnOx при механоактивации смеси порошков ZnO и Zn

SPONGE LIKE POROUS SILICON FORMATION FOR INTEGRATED ELECTROLUMINESCENCE LIGHT EMITTING DEVICES

A. Smirnov[1], A. Stsiapanau[1], E. Mukha[1], Abubakar Saddiq Mohammed[1], J.Garcia[2], A. Hubarevich[3], J. Solovjov[4]

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[2]Valencia Nanophotonics Technology Center, Universidad Politecnica de Valencia, Camino de Vera s/n 8F, 46022 Valencia, Spain

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Integration of electronic and optoelectronic components on a silicon chip is the task of great importance. One of the most difficult optoelectronic element to integrate onto a Si chip is a light emitting device because Si is an indirect band gap semiconductor, meaning that it normally can not produce light.

A standard technological method of high porosity nanostructured silicon formation as functional layer for light emitting devices is electrochemical etching in hydrofluoric acid solution [1]. But this method has some inconveniences such as short anodizing time (few seconds for thin porous layers formation), toxic for operators and aggressive hydrofluoric acid which destroy aluminum interconnections. To avoid these inconveniences we propose to use a solution with low fluorine ions concentration. In this paper we are describing the stable and reproducible method for high porosity silicon formation in novel ammonium fluoride solution.

High doped single crystal Si substrate is used as precursor for nanostructured Schottky junction fabrication, so this material is under our investigation [2]. Change of porosity structure versus anodizing current density for high doped silicon (0.01 Ohm cm, <100> orientation) in 1:2:1 $HF:C_2H_5OH:H_2O$ was published [3]. The porosity anomaly versus current density is absolutely evident. The plot turns and morphology of porous silicon changes from regular vertical holes (at higher current densities) to a sponge like structure (at lower current densities) at 10 mA/cm2.

Our analysis shows that such changes of porosity can be related to electrochemical diffu-sion layer thickness increasing from 30 to about 500 microns while current density declines. This increasing is determined by break off solution agitate by emitted gas burbles. At low current densities value of emitted gas is smaller and practically the whole volume of hydrogen can be dissolved in solution and doesn't form burbles. The critical current is 4.3 mA/cm2 at ambient conditions. Anodizing process can be unstable near this value because of local gas burble agitating and corresponding irregular current distribution. Note, that very high porosities can be achieved at low current densities.

In our experiments we were using $NH_4F:H_3PO_4:C_2H_5OH:H_2O$ solution. The addition of ethanol to this solution allows to moisten the hydrophobic silicon surface and to get more reproducible results. Moreover, the addition of H3PO4 allows to control the ions fluoride concentration and to obtain needed uniformity of porous layers round the whole anodizing area.

Figure 1 shows NH4F concentration dependences on pores size in solution $NH_4F:H_3PO_4:C_2H_5OH:H_2O$ at 0.1 mA/cm2 current density. By increasing of NH_4F concentration from 5 to 20 wt % the pore sizes are reducing from 20 to 10 nm. In addition, the reduction of current density also reduces the pores size. Thus, it is possible to change the pores size by varying of ammonium fluoride concentration and current density. Fabricated layers have a sponge like structure with the porosity in the range of 70–80%.

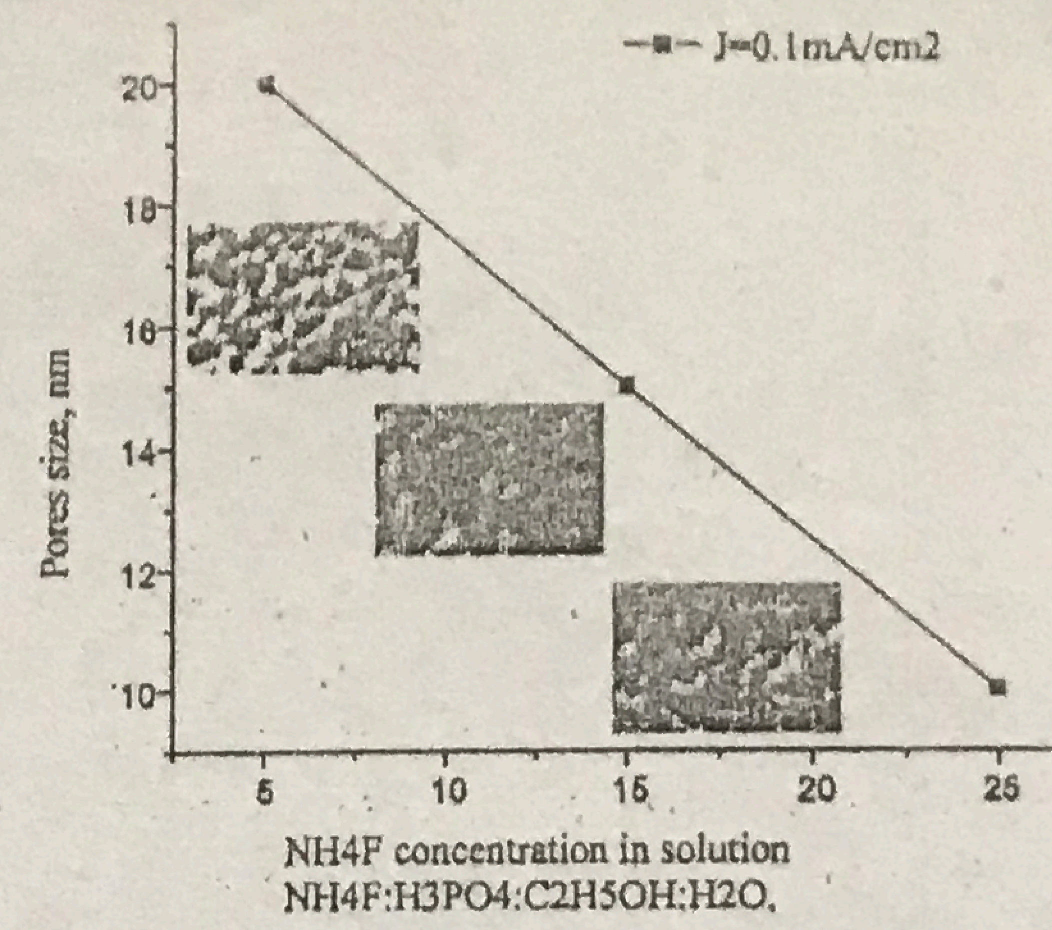

Figure 1 - NH4F concentration dependences on pore sizes

In Fig. 2 the photoluminescence spectrum of 1 μm porous silicon layer and single crystal silicon are presented. As can be seen the emission peak corresponds to 460 nm (blue region).

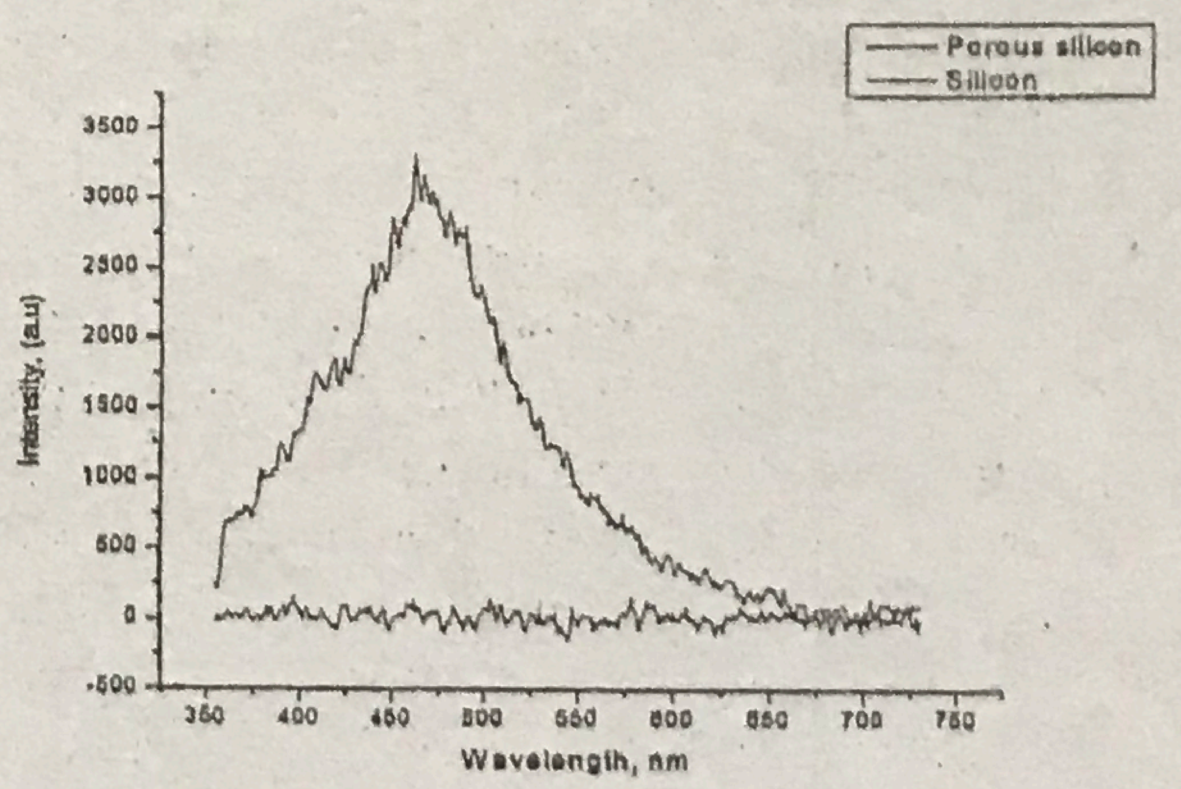

Figure 2 – Comparison of photoluminescence spectrum of 1 μm porous silicon layer and single crystal silicon.

In this work we report the stable and reproducible regime of small pores size high porosity sponge like porous silicon layers formation. These layers can be fabricated at low fluorine ion concentration and anodization current densities. They are effective for the use as light emitters for prospect optoelectronic devices.

References

[1] A. Smirnov, A. Stsiapanau, Abubakar Saddiq Mohammed, Y. Mukha, Ahmed Adnan Hadi, Mohammed Iqbal Dohah, Nanosized metal and anodic oxide films with improved optical features for displays and photonic devices *Physics, Chemistry and Application of Nanostructures*, World Press, Singapore, p.519–522, 2011

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