FORMATION OF NANOCRYSTALS IN A-Si/SiO_2 LAYER BY PLASMA IMMERSION ION IMPLANTATION

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1. Introduction

Silicon has been the major semiconductor used by the microelectronics industry, but it has a weak light emission, therefore it was not considered to be an important element for the optoelectronics applications. Few years ago a visible photoluminescence (PL) emitted by porous Si and by the Si nanocrystals (Si-nc) was discovered. So, Si has become an interesting material for the light-emitting element in the optoelectronics industry, because of its mature technology and domain in the microelectronics. In this work, we do not discuss the origin of the PL in Si-nc. For the moment we propose the usage of recoil ion implantation technique to form a Si-layer into a SiO_2 layer deposited over a Si substrate.

2. Experimental

Our group has been successfully applied the recoil implantation to implant metallic atoms of a deposited film onto a substrate. We use the plasma immersion ion implantation system (Fig. 1) for that purpose. Before the implantation, a 20 nm SiO_2 was deposited on a (100) Si wafer by electron beam evaporation and after that, we added 20 nm of Si film on the SiO_2 by the same technique (see the drawing in Fig. 2). After that the samples were bombarded with Argon (Ar) ions, (75keV) for 60 and 120 minutes, and afterwards annealed under 970ºC for several hours in nitrogen ambient.

3. Results and Discussions

We observed that the maximum in the Raman shift increases with the annealing time as shown in Fig. 3. In Fig. 4 is presented a cross section of TEM images of 60 and 120 minutes of Ar PIII and annealing at 1000ºC for 4h. In these cases the top of Si was removes by sputtering and nanocrystals are present on or near the surface of the single layer above substrate.

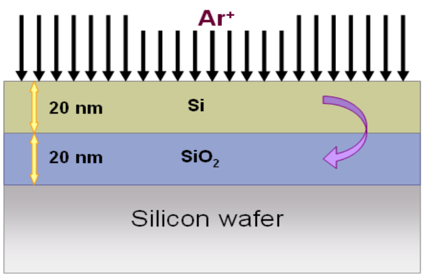

Fig. 1. *Schematics of the films deposited over Si substrate.*

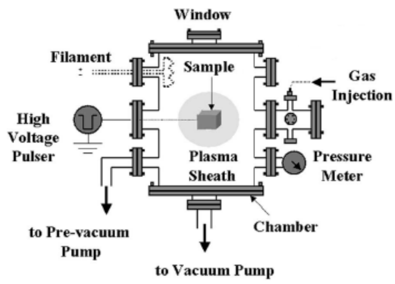

Fig. 2. *Experimental setup of this work.*

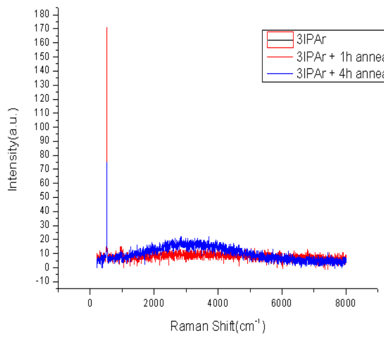

Fig. 3. *Raman shift for different Ar implantation dose and different annealing time.*

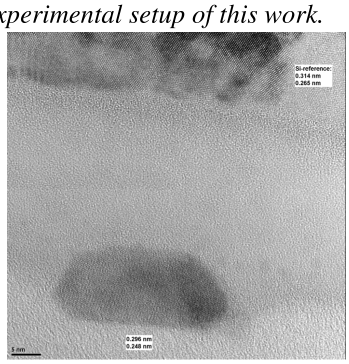

Fig. 4. *Cross section of a sample treated for 120min by Ar PIII.*

4. References

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