Synthesis and Characterization of Nanoporous TiO_2 Films on Silicon Substrates for Solar Cells Applications

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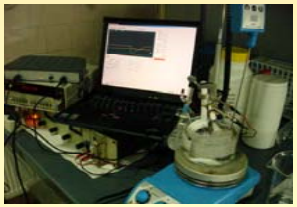
Introduction

Titanium oxide is an interesting and versatile material which is used in many areas of technology, including high efficiency, low cost solar–cells applications due to its chemical inertness, eco–friendly nature and photostability.

Depending on fabricating conditions and further heat treatment titanium oxide can be obtain in several polymorphic forms, including anatase and rutile.

In this work nanoporous titania was investigated in order to achieve a n-TiO_2/Si heterojunction by anodization process which is compatible with silicon photovoltaic technology.



Experimental

TiO_2 samples for solar cells applications were prepared by the electrochemical oxidation of pure titanium thin film deposited onto various substrate types including silicon, SiO_2 and borosilicate glass. Titanium layers of 100 nm thickness were deposited on substrate by sputtering.

Anodization was conducted using a conventional two – electrode system. The influence of anodizing parameters on the surface morphology was investigated in detail to optimize the process in order to obtain the porous structure. The best results have been obtained using a mixture of NH_4F in ethylene – glycol as electrolyte. The applied voltage is 5 V, anodisation time, 120 s, T=300K. The distance between the working and counter – electrode was kept at 5 cm. After anodization, samples were washed, dried and treated at different temperature from 400 to 800 ^{0}C.

Results

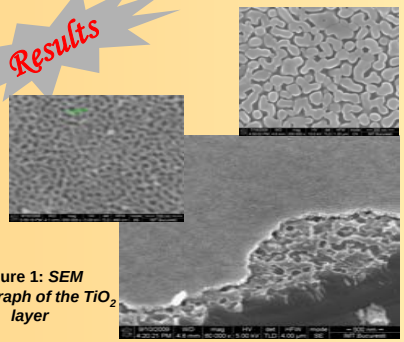


Figure 1: ***SEM micrograph of the TiO_2 layer***

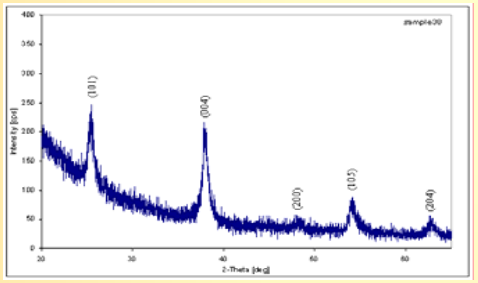


Figure 2: ***X-Ray diffraction pattern of a TiO_2 layer***

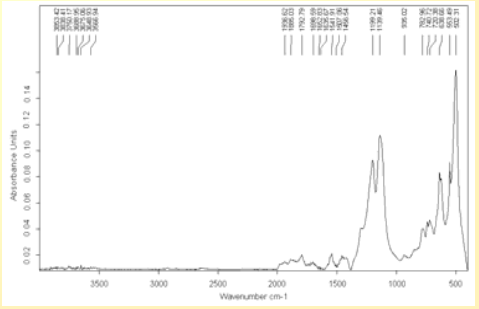


Figure 4: ATR-FTIR spectra of TiO_2 anodization film

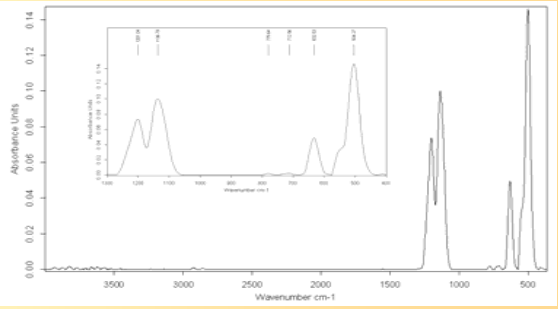
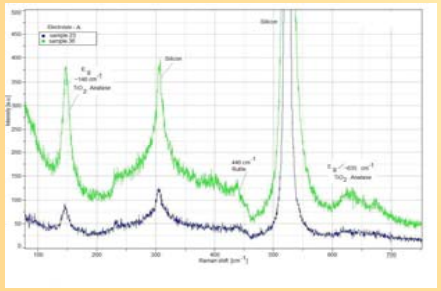
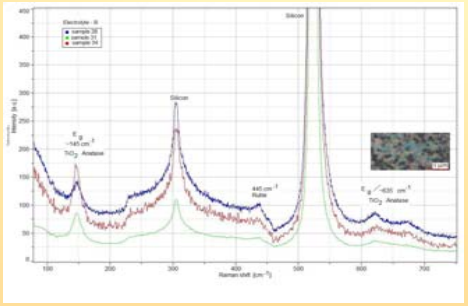


Figure 5: ATR-FTIR spectra of TiO_2 annealing film





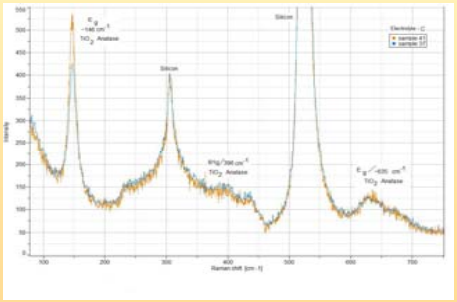


Figure 3: Raman spectra of TiO2 layers on silicon substrates obtained by anodization process

Conclusion

Nanostructured titanium oxide films for photovoltaic applications have been obtained by anodization of titanium thin films deposited by sputtering.

The dependence of layers morphology on anodizing parameters was evaluated in order to optimize the process.

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