# NANOSTRUCTURED PbTe THIN FILMS ELECTROCHEMICALLY DEPOSITED ON POROUS SILICON SUBSTRATE

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Narrow gap semiconductors as PbS, PbSe and PbTe have been extensively studied due their importance for infrared detector technology. Lead tellured epitaxial films have been grown mainly by vacuum techniques. However, recent works [1,2] have shown that chalcogenides like CdSe and PbTe could be epitaxially grown on InP and GaAs single crystals. In this work, nanostructured PbTe thin films were electrodeposited by the first time on porous silicon substrates from aqueous alkaline solutions of $Pb(CH_3COO)_2$, disodium salt of ethylendiaminetetraacetic acid (EDTA) and $TeO_2$ by using a current density between 0.14 to 0.20 mA/cm$^2$. By using this range of current density the potential during the film growth was monitored in the range of –1.0 to –0.8 V x Ag/AgCl. Cyclic voltammetry was also used for studying the film deposition reaction and for finding the appropriate deposition potential range. The porous silicon substrate has presented a nanometric porosity obtained by stain etching for different concentrations of HF and $HNO_3$, characteristic for highly doped p silicon. The mechanism of porous silicon formation is a complex process and the limited thickness for porous silicon layer (PSL) depending on the doping type and concentration. A strong photoluminescence characteristic for PSL was also evidenced as a function of the time etching and $HNO_3$ concentration.

It was obtained PbTe polycrystalline thin films that presented Pb peaks on XRD spectra. Films deposited with lower current density have shown a more uniform morphology. Porous silicon substrates and PbTe films were analyzed by Scanning Electron Microscopy (SEM), Raman Scattering Spectroscopy and X-Ray Diffraction (XRD) measurements. Fig. 1 shows a cross section SEM image evidencing a PSL with a thickness of around 1 μm. According to high resolution XRD analysis a $p^+$ porous layer also exhibit low stressed crystalline structure. SEM morphology image for an electrodeposited polycrystalline PbTe film on above substrate is shown in Fig. 2, by using a current density of 0.14 mA/cm$^2$. The current density control is a critical parameter because the range of potential for promoting an epitaxial growth is very narrow. Fig. 3 present a (XRD) measurement for such film, where can be observed the PbTe (200), (220), (222) e (400) peaks.

[1] L. Beaunier, H. Cahet, R. Cortes, M. Froment, G. Maurin, J.Electrochem. Soc. 147 (2000) 1835.
[2] L. Beaunier, H. Cahet, R. Cortes, M. Froment, G. Maurin, J.Electroanal. Chem.-*in press*.

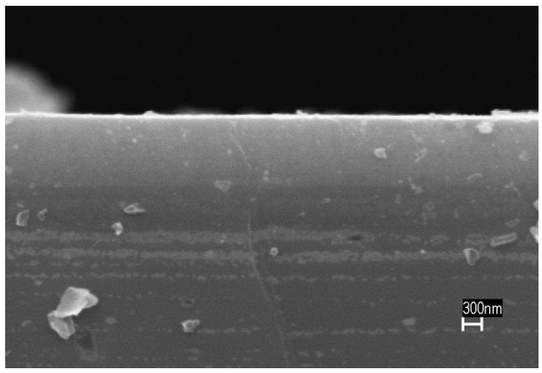


Fig.1. SEM cross section image for PSL with a thickness of around 1 μm. Stain etching during 3 min in HF:$HNO_3$, 100:1, with addition of 0.1 g/l $NaNO_2$.

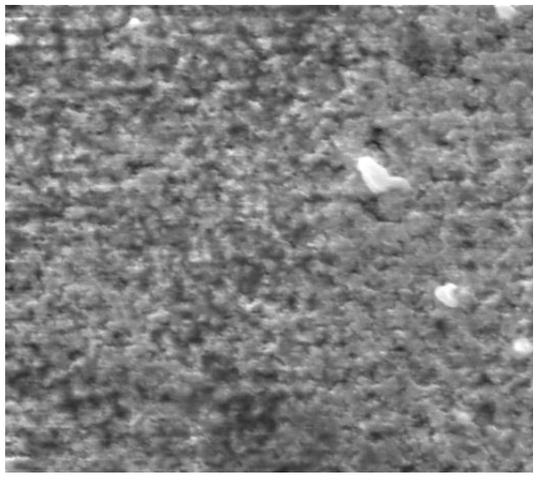

Fig. 2. SEM image (5000 X) of a electrodeposited PbTe film on PSL during 30 min at a current density of 0.14 mA/cm$^2$.

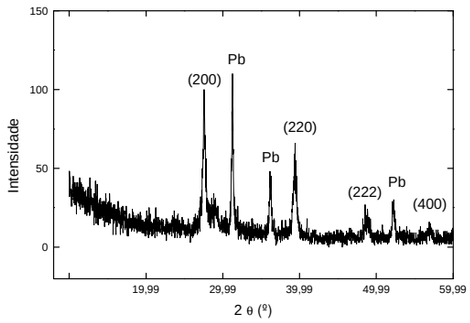


Fig. 3. XRD measurement of a electrodeposited PbTe film on PSL during 30 min at a current density of 0.14 mA/cm$^2$.