Thin Film Measurement solution
Software, sensors, custom development
and integration

Measurement of the Porous Si

Porous Si is, typically, grown in Si wafer by etching in chemical solution or/and anodizing. To optimize the process parameters one needs to determine the thickness and porosity of the porous Si. These parameters are frequently determined using SEM and gravimetric analysis – a time consuming methods. Gravimetric analysis can be quite challenging for bi-layer or non-uniform porous Si layer.

Spectroscopic reflectance offers a quick and simple method to determine both thickness and porosity. From the optical point of view porous Si can be thought of as a physical mixture of Si and void and represented using effective-medium approximation. In addition, the model needs to correct for light-scattering and interfaces. Spectroscopic reflectance is not sensitive to anisotropy and using Visible -NIR region one can minimize the effect of optical constants change in Si.

Several porous Si samples were measured using MProbe Vis system (400-1000nm wavelength range): thin porousSi (sample 1), thick porous Si and bi-layer porous Si

83 Pine Hill Rd. Southborough, MA 01772
Phone +1.617.388.6832 Fax. +1.508.858.5473
email: info@semiconsoft.com http://www.semiconsoft.com

Sample 1. Thin porous Si (low porosity)

Model: top layer/ porous Si/Si
Top layer is a "Si –rich" porous Si (mixture of Si+porous Si)
Porous-Si represented using EMA: Si+void
Measured parameters: Thicknesses of the 2 layers, porosity of porous Si, scattering correction factor.

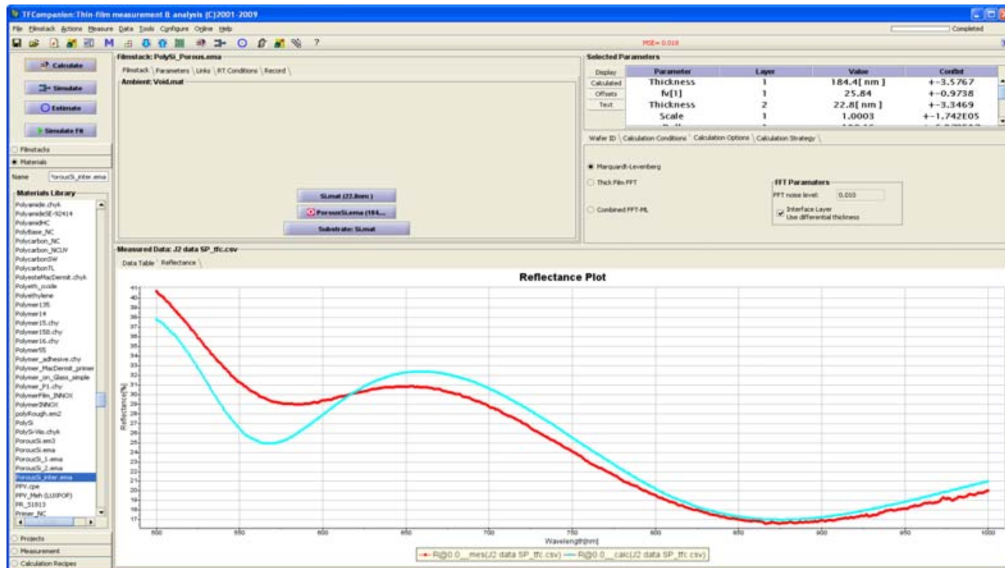

Fig. 1. Model to measured data fit. Sample 1 – thin porous Si. Thickness: 207nm (184 main porousSi layer+23nm top layer) , porosity =25%

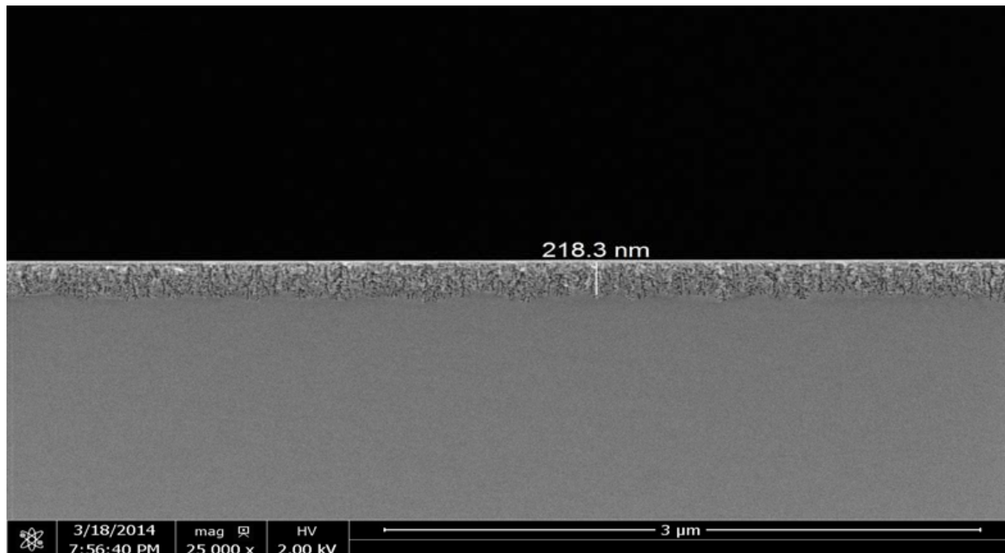

Fig. 2. SEM image of the sample from the same batch as Sample 1.

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Sample 2. Thick porous Si.(high-porosity)

For the thick film we can limit the measured spectrum range and simplify the model (scattering can be ignored at longer wavelenths)

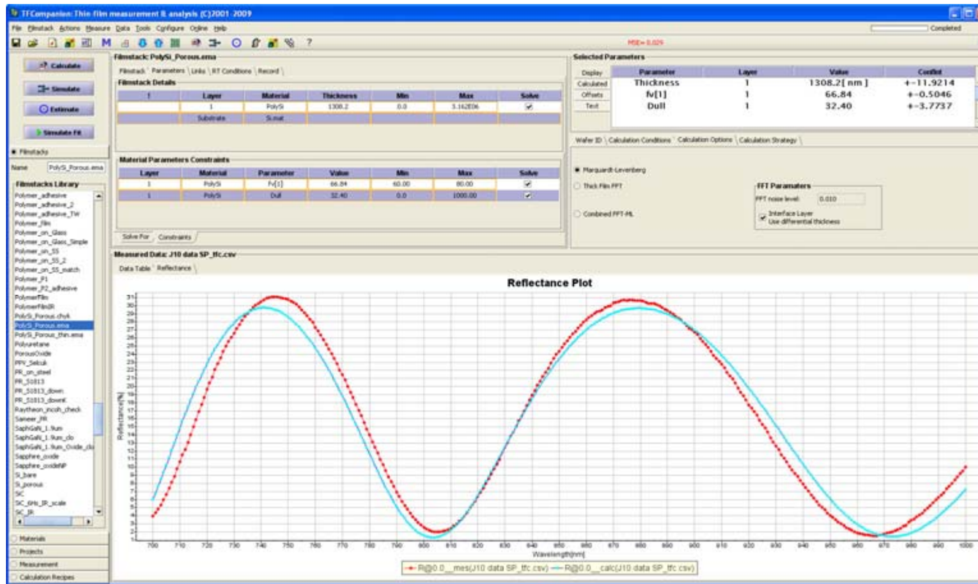

Fig. 3. Sample 2 Model to measured data fit . Thickness:1300nm, vf. 66%

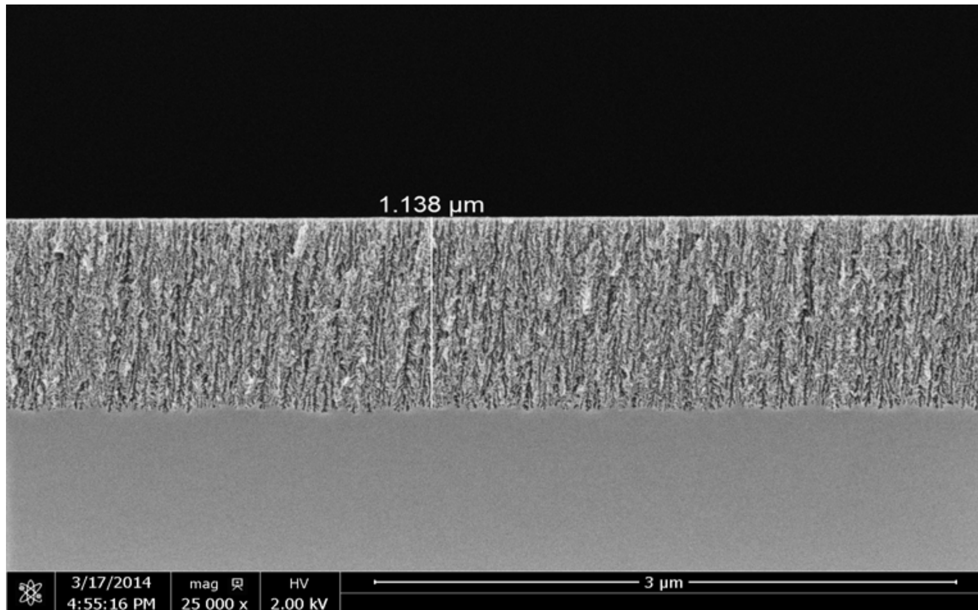

Fig. 4. SEM image for the sample in the same batch as sample 2

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Sample 3. Porous Si Bi layer

Model include two porous Si layer and top "Si-rich" layer

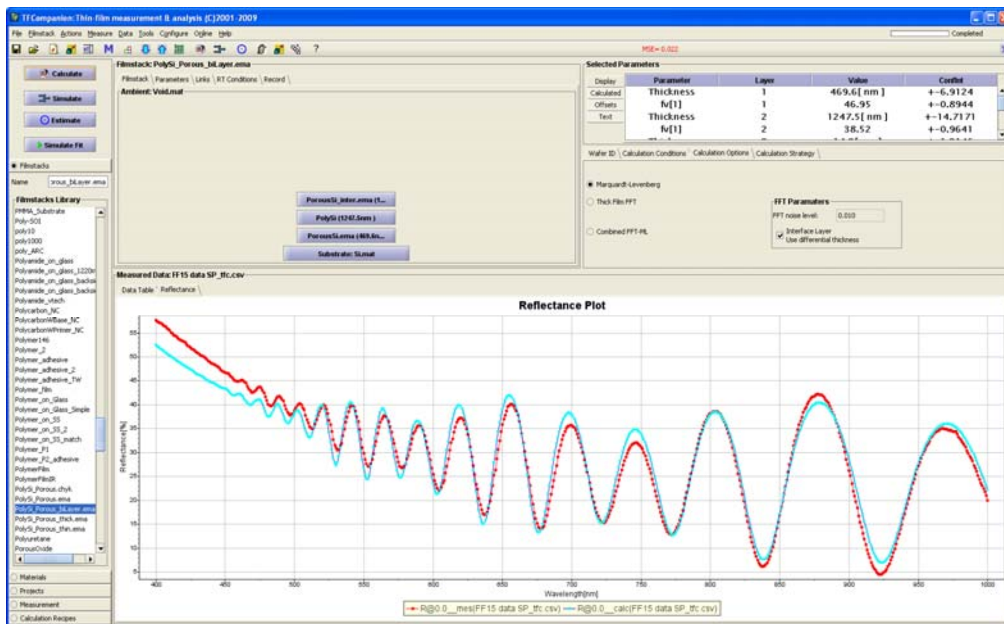

Fig. 5. Sample 3 Model to measurement fit in the full range (400-1000nm).
Thickness(bottom layer): 505nm (470nm+35nm), porosity: 47%
Thickness (top layer): 1248nm, porosity: 38%
Note. Small discrepancy at the shorter wavelengths is due to change of the optical properties of Si in the top interface layer.

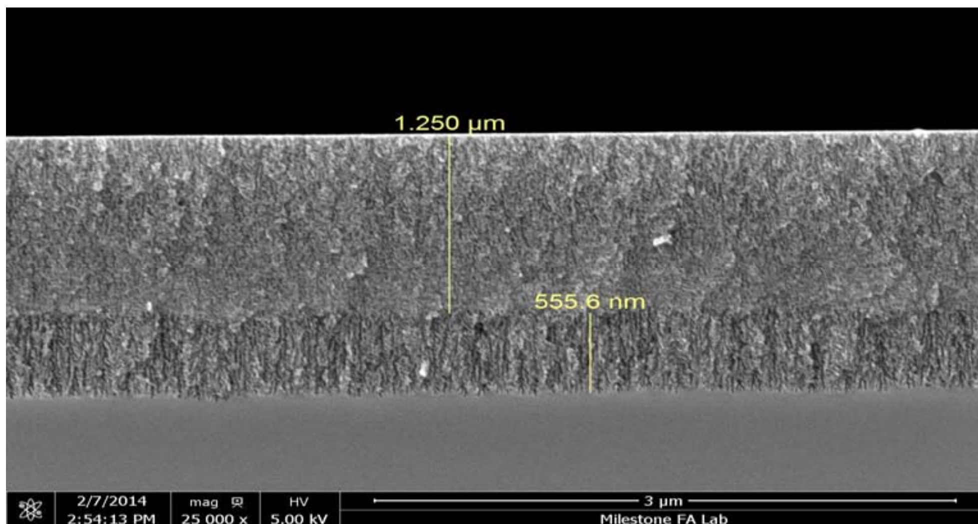

Fig. 6. SEM image of the sample in the same batch as sample #3

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