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

# SiGe Multilayer stack measurement.

## SUMMARY

SiGe is widely used in semiconductor and power conversion applications. One of the applications is TEC (thermoelectric cooler) and reverse- power to electricity converter. In this application the thicknesses of the SiGe and buffer layers need to be tested/monitored. Composition of he SiGe is, generally, stable but crystallinity/amorphization need to be checked.

There samples were measured using MProbe UVVisSR system in 200-1000nm wavelength range.

Samples had a following nominal structure:

1. Sample#1 50nm Si buffer/Si (reference)
   Measurement result: 36.2nm oxide buffer /Si.
   36.2 nm oxide buffer layer = 1.6nm SiO/34.6nm
2. Sample #2 10nm SiGe/50 nm Si buffer/Si.
   Measurement result: 6.1nmSiGe/36.2nm buffer/Si
3. Sample# 3 10nm Si/10nm SiGe/50 nm Si buffer/Si
   Measurement result: 18nm oxide/7.2nm aSi/6.1nmSiGe/36.2nm buffer/Si

Reflectance measurement data is presented on Fig. 1

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

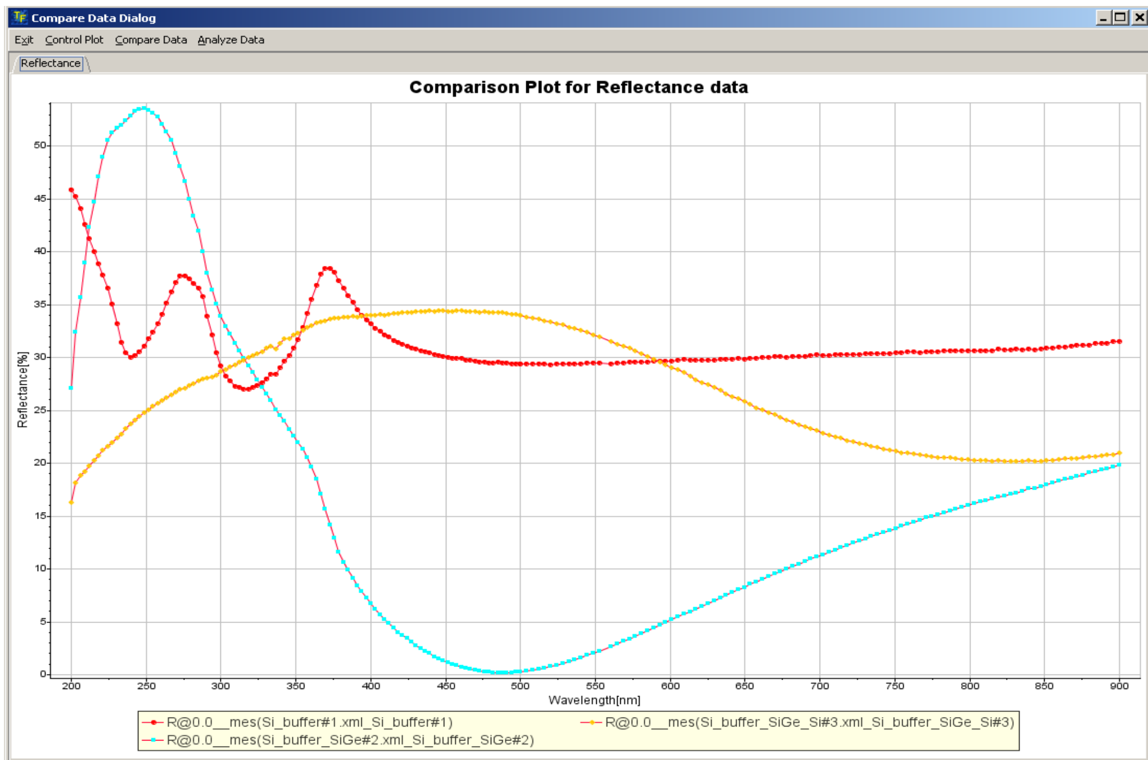


**Fig.1 Reflectance measurement data for three samples**.

Red line – sample #1 Double-peak Si electronic transitions structure is clearly visible.

Blue line – sample #2 amorphous/polycrystalline Ge spectrum dominates the reflectance

Yellow line – sample #3 shows completely amorphous material spectrum

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

DETAILS

Sample 1.

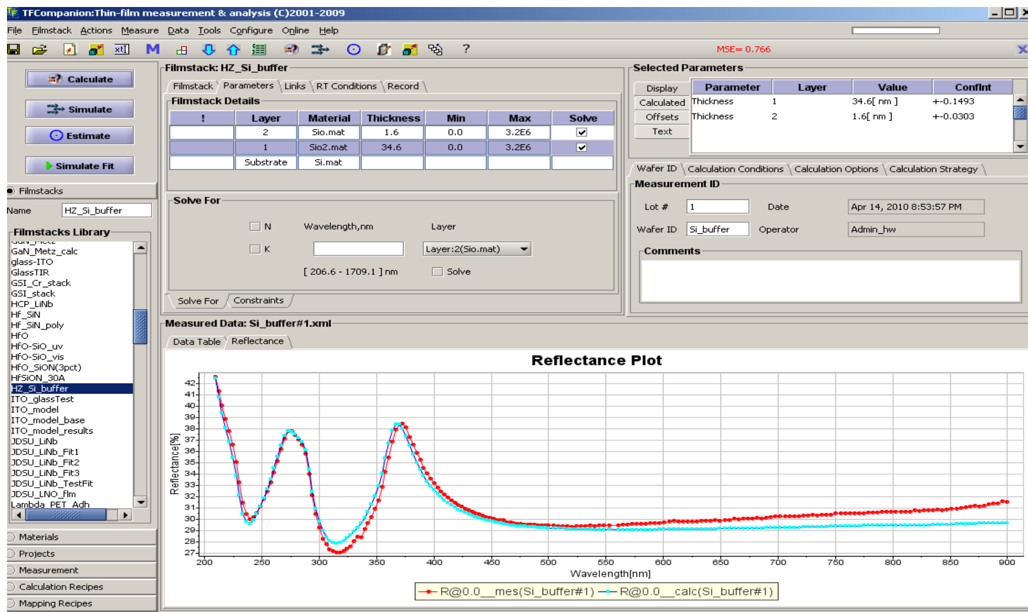


**Fig. 2** Sample #1 results of the fit model to measured data using 1.6nm SiO/34.6nm SiO2/Si model

Sample #2

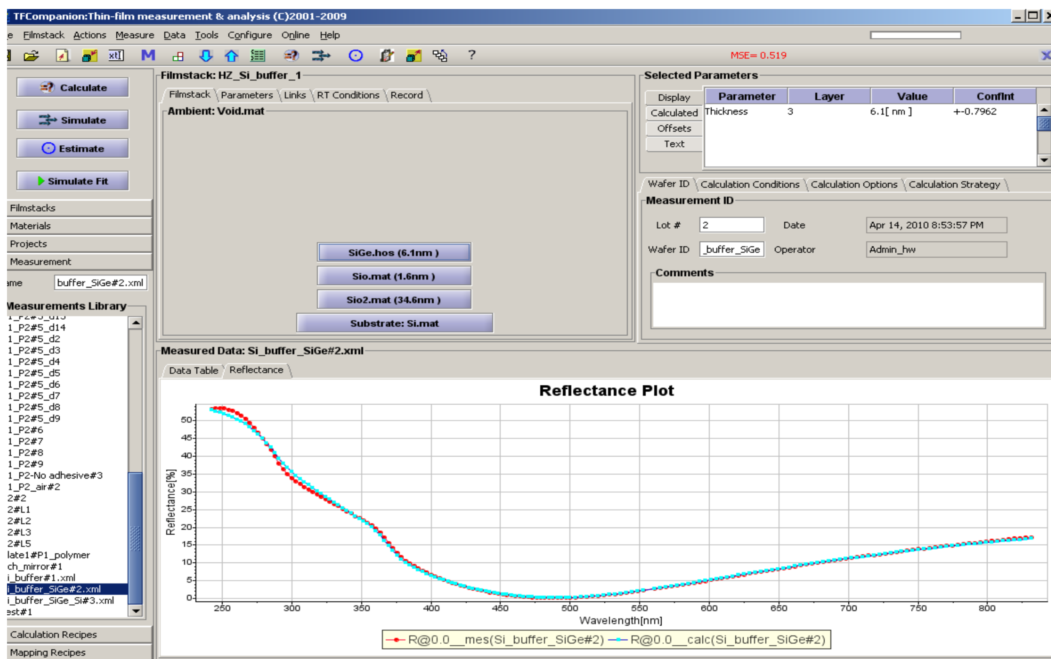


Fig. 3 Sample #2 Best fit for the model to measured data: 6.1nmSiGe/36.2nm buffer/Si. Optical dispersion of the SiGe is determined from the fit. (see Fig. 4)


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

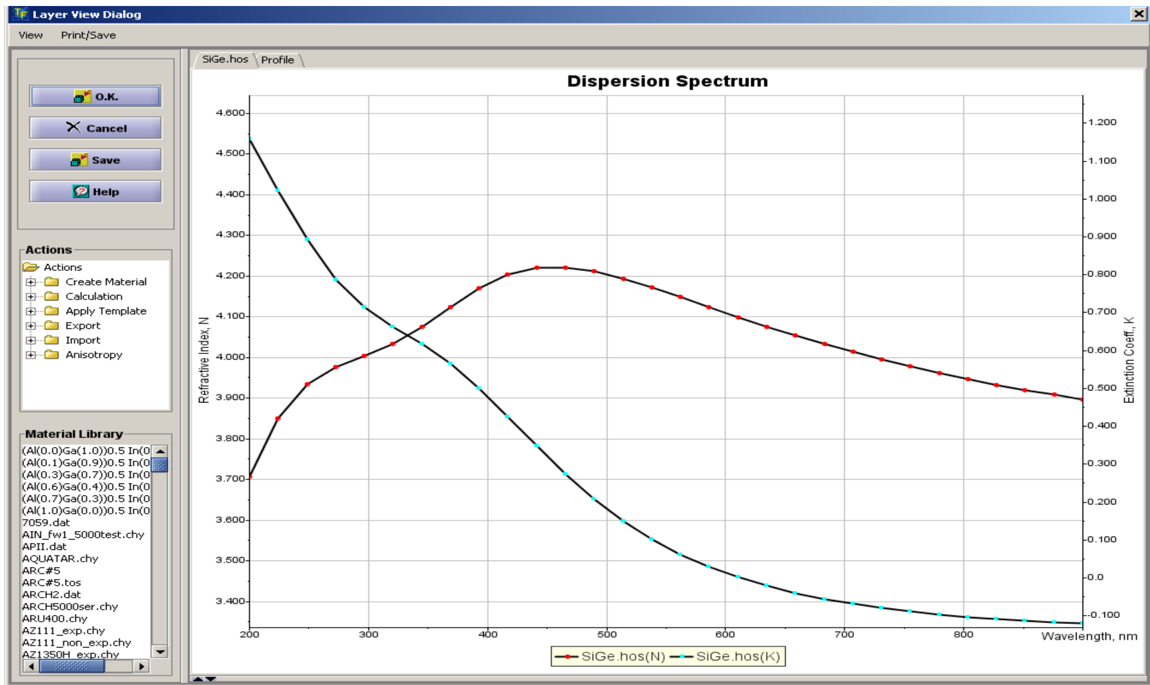


Fig. 4. Sample #2 SiGe optical dispersion determined from the fit.

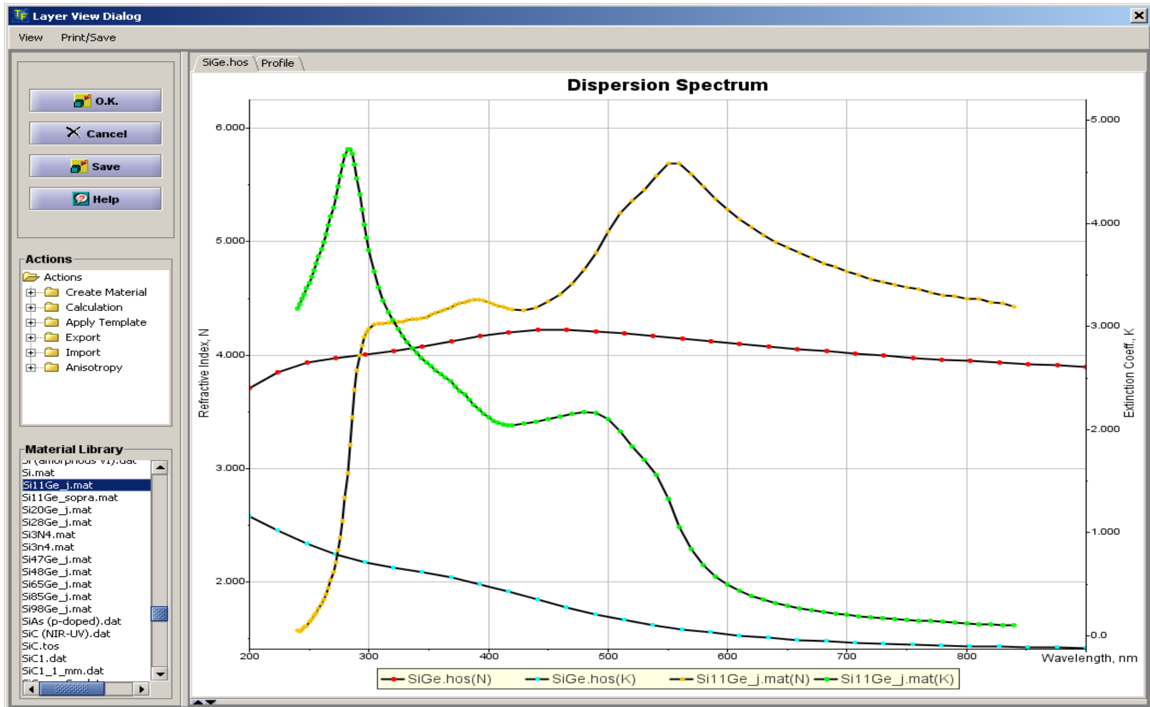


**Fig. 5**. Sample #2 SiGe optical dispersion compared with crystalline $Si_{11}Ge_{89}$ material. Broad features of the SiGe material in Sample #2 show that it is amorphozed.

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 #3

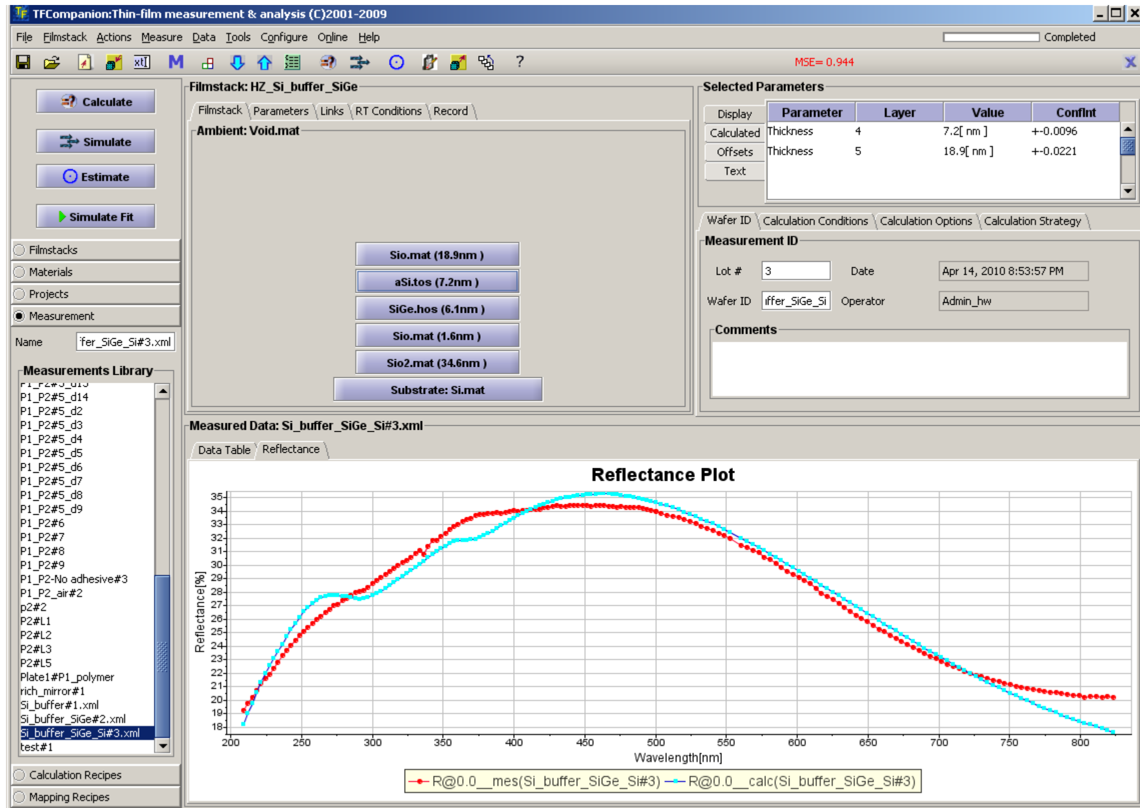


**Fig. 6** Sample #3. Best fit of model to measurement data. . Best fit filmstack: 18.9nm oxide/7.2nm aSi/6.1nmSiGe/36.2nm buffer/Si. aSi dispersion is represented using Tauc-Lorentz approximation. aSi and oxide layer thickness are measured (the rest of the filmstack parameters are taken from sample#2 model )