

Determination of Thin Film Thickness and Composition using Energy Dispersive EPMA

Ralf Terborg^{1*}, Kyung Joong Kim² and Vasile-Dan Hodoroaba³

¹ Bruker Nano GmbH, Am Studio 2D, 12489 Berlin, Germany

² Korea Research Institute of Standards and Science (KRISS),
Division of Industrial Metrology, Daejeon, Korea Federal Institute for Materials

³ Research and Testing (BAM), Division 6.1 Surface Analysis and Interfacial Chemistry, Berlin,
Germany

*ralf.terborg@bruker.com

The determination of the thickness and composition of thin films on substrates is important to characterize layered sample systems. There are various techniques for the determination of thin film thickness available, e.g., profilometry, ellipsometry, atomic force microscopy (AFM), or X-ray reflectometry. For the additional determination of thin film composition techniques like X-ray photoelectron spectroscopy (XPS) or mass spectrometry-based techniques can be used.

An alternative non-destructive technique is electron probe microanalysis (EPMA). This technique assumes a sample of homogenous (bulk) chemical composition and can therefore not be used for thin film samples. However, in combination with the thin film software STRATAGEM [1] the thickness as well as the composition of such films on a substrate can be determined.

This has been demonstrated for FeNi on Si and SiGe on Al₂O₃ film systems [2, 3]. For both systems five samples with different elemental composition and a reference were produced and characterized by Korean research institute KRISS using inductively coupled plasma mass spectrometry (ICP MS), Rutherford backscattering (RBS), and transmission electron microscopy (TEM). These samples were used for an international round robin test.

In 2021, a new and open-source thin film evaluation program called BADGERFILM has been released [4]. It can also be used to determine thin film composition and thickness from intensity ratios of the unknown sample and standards (k-ratios).

In this contribution, we re-evaluated the data acquired for the FeNi and SiGe systems using the BADGERFILM software package and compared the resulting composition and thickness with the results of the established STRATAGEM software and other reference methods, see Figs. 1 and 2. With the current evaluation, the BADGERFILM software shows good agreement with the composition and thickness calculated by STRATAGEM and provided by the KRISS.

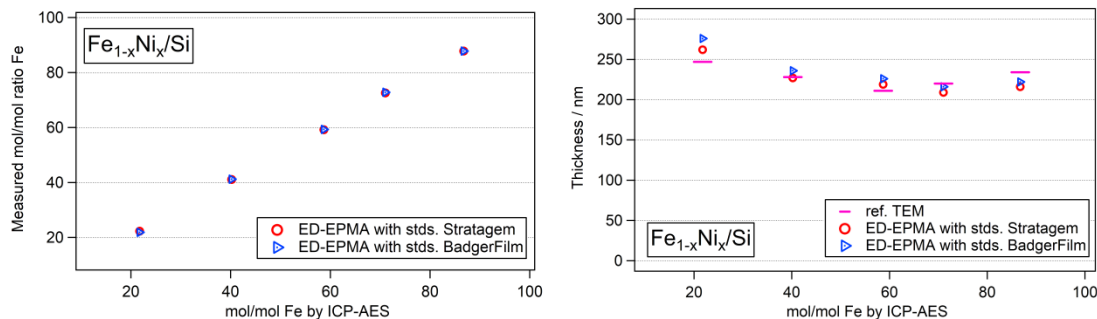


Figure 1. Reference (by ICP-AES) and measured composition and thickness of five samples of the FeNi on Si system.

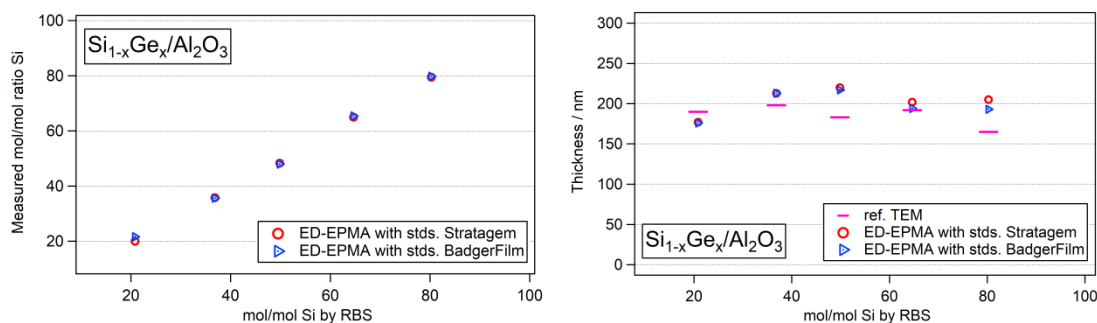


Figure 2. Reference (by RBS) and measured composition and thickness of five samples of the SiGe on Al_2O_3 system

References :

- [1] Stratagem Version 6.7, SAMx, www.samx.com, 1554 route de la Roquette, 06670 Levens, France
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- [4] A Moy A and J Fournelle, *Microsc. Microanal.* **27** (2021) 284