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Plenary - In situ RBS and XRD investigation of thin film formation

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Abstract content
   (Max 300 words)

Thin films formed by solid phase reaction often exhibit a complex composition of several atomic species. The (re)distribution, diffusive and reactive properties of the individual species as well as their relative motion upon thermal treatment have a distinct influence on the formation properties and thus on overall thin film properties. X-ray diffraction (XRD) and Rutherford backscattering spectrometry (RBS) measurements have proven most valuable in the study of thin film formation as a function of thermal treatment. RBS is ideally suited when the compositional depth profile of thin films plays a crucial role. On the other hand, X-ray diffraction provides very valuable information on the lattice structure (hence the phase!) and texture of the material.

Conventionally, several specimens are subjected to different heat treatments and subsequently analyzed one by one for a complete overview of the response of a thin film to thermal annealing. Because of the discrete character of this approach, however, critical stages for the understanding of the development of thin film properties (such as transient phase formation) are easily overlooked. This problem is avoided by determining the specimen properties in real time, i.e. during annealing with a high sampling rate [1]. Additionally, real-time measurements drastically decrease the workload, as kinetic parameters, redistribution properties and phase sequence, for example, can be obtained from a combined ramped RBS or XRD annealing, while numerous specimens have to be analyzed in the conventional approach.

To illustrate the strength and complementarity of these real-time techniques, we will present a number of examples of (ternary) silicide and germanide thin film growth processes by thermal annealing. First, we will discuss the real-time determination of (re)distribution of Pt during Ni(Pt)Si formation in a solid phase reaction, using three different sample configurations, i.e. a homogeneous Pt-Ni alloy, a Pt capping layer and a Pt interlayer, all containing the same Pt/Ni atomic ratio (varying from 0 to 10 at. %) [2,3]. Secondly, we have applied a real-time approach to investigate the dominating diffusing species during nickel and palladium germanide formation, two of the most promising candidates for use as ohmic contacts were germanium to replace silicon in devices.

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