Modelling and synthesis of thin film by plasma diagnostics in magnetron sputtering.

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Abstract

Thin film metallization technology is recently changing to new paradigm in a way to nano-scale precision, versatile nucleation and growth control, and ultra low temperature processing less than 100 C etc.. Significant scientific and technological progress has been achieved in a variety of plasma processing.

It is crucial to understand the theoretical mechanism of film nucleation and growth for control of microstructure and corresponding film properties, and then design for new functional film structure and synthesis process. The film nucleation and growth is closely controlled by the total energy to be delivered to the substrate surface by energetic particles and other external energy sources such as heating or cooling during sputtering. The energy is comprised of three major energy terms which are physical energy, thermal energy and chemical potential including electronic energy. The energy is analyzed measured by integrated diagnostics of plasma parameters and surface temperature measurement.

This paper discusses on the mechanism of energy transfer at the substrate surface during magnetron sputtering and changes of sputtered particles energy and surface temperature with variation of process parameters during magnetron sputtering by integrated plasma diagnostics.

The modelling of thin film structure and process is then discussed for synthesis of thin films with specified microstructure and properties at low temperature and compared with empirical data measured for the films deposited on polymer substrates by magnetron sputtering at various process conditions. The design principle is finally proposed for functional metallization on polymer substrates by magnetron sputtering.