

Preface

Sputtering plays a crucial role in the preparation of thin films of metals, semiconductors, and insulators for many industrial applications. Although other deposition techniques such as evaporation, electroplating, and chemical vapor deposition exist, sputtering, because of the numerous controllable parameters involved, offers an excellent opportunity for manipulating such basic physical properties as conductivity, grain structure and size, morphology, impurity or dopant level, adhesion, optical transmission, etc., as well as dimensional (film thickness) and chemical (composition) properties.

Sputtering involves generation of energetic ions that are directed toward a target, which in turn is ionized. In the presence of inert gases, such as argon or helium, target materials can be deposited as thin films on substrates or sputtered ("etched") away. In the presence of reactive gases, such as O_2 , N_2 , or CH_4 , chemically modified films (e.g., oxides, nitrides, carbides) can be deposited.

Plasma etching (or reactive ion etching) can be considered to be related to reactive sputtering. Here, the energetic ions also produce reactive neutral species in the plasma that react with the target material to form volatile (versus involatile) products; these are subsequently removed by vacuum. The chemical reactivities of these neutral radical species are also uniquely altered under the influence of the ion bombardment. Thus, a mechanism now exists for the precise control of etch rates. The exact reasons for the changes in etch rates are not completely understood and remain an area of active research.

Plasma etching processes have become increasingly competitive with classical wet chemical methods for the fabrication of semiconductor devices, particularly for small, high-density devices. Plasma etching has the capability for finer resolution and control of etched lines (linewidths and profiles). It can also be used for sequential etching and stripping of resist materials, and reduces or eliminates the need for large volumes of hazardous chemicals. In addition, plasma etching readily lends itself to automated processing.

The first four papers in this issue address work in the areas of sputtering and reactive ion etching. The lead paper by J. H. Keller and W. B. Pennebaker discusses a theory developed to understand and predict dc and rf electrical parameters of rf sputtering systems. This work should prove useful both for new system design and for diagnostic work on existing systems.

The companion paper by W. B. Pennebaker discusses the mathematical modeling of scattering and ionization in glow discharge sheaths and provides a simple means for calculating the rf impedance, particularly at high pressures, where previous models often fail.

The related paper by J. H. Keller and R. G. Simmons considers a new theory for computing the backscatter of sputtered material. The authors use the model to predict

deposition rates for sputtering systems with parallel-plate geometries.

Taken together, these three papers provide a comprehensive model that allows one to understand and predict many of the complex parameters involved in sputtering processes.

The subject of reactive ion etching is treated in the paper by J. W. Coburn and Eric Kay. The authors discuss discharge chemistry in the presence of additive gases such as O_2 , H_2 , N_2 , H_2O , and C_2F_4 for low-pressure, long-residence-time situations. They find that the etch rates of silicon and its compounds are determined primarily by the elemental composition of the glow rather than by the particular gaseous species present. Because of this, the etching behavior of a large class of gaseous mixtures, as well as the role of various electrode and wall materials, can be predicted.

The paper by J. Pacansky and J. Lyster discusses the photochemical decomposition mechanisms of AZ-type photoresists. The authors explain how some of these systems can behave as both positive and negative photoresists based on the particular sequence of exposure and processing steps.

Two other papers in this issue deal with polymer films in their application to flexible magnetic storage media. Data tracks on these disks are subject to distortion due to anisotropy in mechanical properties, thermal and hygroscopic expansion, and long-term dimensional instabilities. This distortion is the most important limitation to high-density magnetic recording. The first of these papers (both by Blumentritt) considers the use of laminated polymer films as a means of reducing anisotropic in-plane properties to increase recording density. His companion paper describes annealing of polymer disks as another approach toward improving dimensional stability.

The paper by Franaszek treats the problem of formulating synchronous codes for input restricted communication channels. Conventional coding techniques produce codes in which the code word depends only on the current state of the channel and the information represented by the word. This paper describes a class of codes that may also depend on future information to be transmitted.

Less computational effort is required when network designers check system states for deadlock using an algorithm described by V. Ahuja.

The long-standing problem of analyzing the break-up of a liquid jet received new impetus because of greater interest in ink jet printing. A differently formulated solution to this problem is presented by D. B. Bogoy.

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