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Physics of Thin Films

Advances in Research and Development

PLASMA SOURCES FOR THIN FILM DEPOSITION AND ETCHING

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Design of High-Density Plasma Sources for Materials Processing

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I. Introduction

The advent of sub-micron electronic device fabrication has brought unprecedented demands for process optimization and control (*1*,*2*) which, in turn, have led to improved plasma reactors for the etching and deposition of thin films. As a result, we have witnessed the introduction of a new generation of plasma systems based on electron cyclotron resonance (ECR) heating (*3–6*). ECR plasma etching of polycrystalline Si, single crystalline Si, silicides, Al, Mo, W, SiO_2, polymers, and III–V compound semiconductors have all been reported in recent years (*7–33*). Similarly, ECR plasmas have been used to deposit amorphous Si, silicon nitride, boron carbide, and SiO_2, to name just a few materials (*34–40*). Applications of ECR plasmas beyond etching and deposition have also been reported and include ion implantation (*41–45*), surface cleaning (*46–59*), surface passivation (*60*), and oxidation (*53*,*61–63*). Besides ECR, many other "novel" plasma generation schemes are now being offered to satisfy manufacturers' needs in these materials processing areas. All these schemes purport to offer advantages over conventional approaches such as the capacitively coupled radio frequency discharge now used in many factories for etching and deposition of thin films during integrated circuit manufacturing.

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