Digest of Tech. Papers The 7th Conf. on Solid State Devices, Tokyo, Sep. 1975

A-7-1 THIN FILM EVALUATION TECHNIQUES FOR THE ESFI SOS TECHNOLOGY

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The transistor parameters of the ESFI ®SOS field-effect transistors strongly depend on the properties of the thin epitaxial silicon film on the sapphire substrate: thickness (< 0.8 µm), crystal quality, doping concentration and profile, interface states and lateral homogeneity.

The crystal quality is measured by means of the optical absorption (E = 2.0 to 2.7 eV) obtained by the reflection interference method similar to the film thickness evaluation. An appropriately defined optical absorption factor characterizes the crystal quality very well and was gauged by other more direct methods like ion backscattering, electron diffraction and Hall measurements. The results of all these methods show a good correlation with each other. The quality of the film is good near the silicon surface (similar to the bulk values), but rather poor near the silicon/substrate interface due to heteroepitaxial growth. By step-by-step etching and measuring the correlated absorption coefficient the quality profile is obtained.

The method of controlled depletion [1] was improved by computer evaluation and was used as a tool to study the activation, diffusion and pile-down of implanted boron ions in the silicon films. Hall measurements support the analysis of doping changes due to high temperature processes. The method [1] also reveals the space charge influenced by the silicon/substrate interface states.

On the basis of the optical and electrical profiles their influence on the transistor properties can be understood. Thus one is able to optimize the SOS-process as a whole starting from substrate preparation up to the critical high temperatures during the MOS processing.

[1] J. Tihanyi, Siemens Forsch.- u. Entwickl.-Ber. 1. (1972) 263