

trapping drift, i.e. $\Delta V_{FB}(-BT) < \Delta V_{FB}(+BT)$. These effects are discussed in the light of Deal's model of the structure of the Si/SiO₂ interface.

Influence of Se atoms on the properties of amorphous Ge. M. KUMEDA, M. ISHIKAWA, M. SUZUKI and T. SHIMIZU. *Solid St. Commun.* **25**, 933 (1978). Electron spin resonance (ESR), electrical and optical measurements have been made for Ge_{1-x}Se_x ($0 \leq x \leq 0.35$) films in order to elucidate relations between tetrahedrally bonded amorphous semiconductors and chalcogenide amorphous semiconductors. The ESR signal due to dangling bonds in amorphous Ge decreases by increasing Se content. For more than about 20 at.% Se, the electrical conductivity is the activation type and the optical gap increases with the increase of Se content. The model of charged dangling bonds by Street and Mott seems to explain the experimental results.

Inorganic dielectric films for III-V compounds. B. L. SHARMA. *Solid St. Technol.* p. 48 (February 1978). Inorganic dielectric films serve many essential functions in modern solid state device technology and are finding more and more applications in III-V compound semiconductor devices. In this review an attempt is made to survey and present the various methods used for depositing these films on III-V compound surfaces. Apart from the reported applications of these films (tabulated in the text), various methods used for their characterization are also included in tabular form and the capabilities and limitations of some of them are discussed briefly. The future trends in this field are kept in mind during most of the presentation.

Interaction between two hybrid modes in n-GaAs. S. GUHA and P. K. SEN. *Int. J. Electronics* **44**, (4) 375 (1978). Small-signal temporal instability has been studied in n-GaAs in the range of the electric field for which the electron concentration in the central and the satellite valleys are comparable to each other. The sample is subjected to a crossed d.c. electric field E_0 and magnetic field B_0 and the wave is assumed to be propagating perpendicular to the plane of E_0 and B_0 . The light electron hybrid mode (E_{1x}, E_{1z}) interacts with the

heavy electron hybrid mode and thus produces hybrid-hybrid interaction. The diffusion-incorporated dispersion relation has been derived, taking into account the appropriate scattering mechanisms at 300°K. It is analysed to look for instability for real k and complex ω ($=\omega_r + i\omega_i$). One of the modes becomes unstable and propagates with a phase velocity equal to the transverse drift velocity of the light electrons. Instability is possible in the range of the magnetic field $2.5 \leq B_0 \leq 6.0$ Tesla. The instability is observed only for small values of k . At large k the modes are damped, even at comparatively lower values of B_0 .

Resistivity measurement of thin doped semiconductor layers by means of four point-contacts arbitrarily spaced on a circumference of arbitrary radius. EGBERT HESSE. *Solid-St. Electron.* **21**, 637 (1978). The resistivity of a thin doped semiconductor layer or wafer measured in the vicinity of four point contacts placed on the semiconductor surface is shown to be independent of the relative distance between the contacts, provided the contacts are located on a circumference, and the distance to the boundary of the surface will not fall short of the greatest actual spacing between contacts. This method combines the advantage of the four probe resistivity measurement originally proposed by Valdés, that is the determination of ρ in a restricted layer region, with the advantage of arbitrary spacing of the probes, which characterizes van der Pauw's method. Experiments are in agreement with results obtained by the measuring methods of Valdés and van der Pauw.

Recombination-generation currents in degenerate semiconductors. OLDWIG VON ROOS. *Solid-St. Electron.* **21**, 633 (1978). The classical Shockley-Read-Hall theory of free carrier recombination and generation via traps is extended to degenerate semiconductors. A concise and simple expression is found which avoids completely the concept of a Fermi level, a concept which is alien to non-equilibrium situations. Assumptions made in deriving the recombination generation current are carefully delineated and are found to be basically identical to those made in the original theory applicable to nondegenerate semiconductors.

8. THICK- AND THIN-FILM COMPONENTS, HYBRID CIRCUITS AND MATERIALS

The development of precision thin film resistors for submerged repeater applications. D. O. SPILLER. *Electrocomp. Sci. Technol.* **5**, 9 (1978). The paper describes development of a low inductance thin film resistor series with a stability of $\pm 0.15\%$ change in resistance, over a 25 year life, in a submerged repeater environment. (40% RH maximum and 0 to 30°C ambient temperature.)

It was first necessary to establish an appropriate mathematical model relating resistor stability with time and temperature. This was devised from experimental data based on measured resistor drift at various temperatures, and enabled acceleration of resistor drift to be carried out to ensure that each resistor possessed the required stability.

Deposition of a secondary nichrome layer protects the gold/nichrome interface and promotes SiO₂ adhesion. This results in an improvement in the basic elevated temperature resistor stability by minimising diffusion effects of nichrome into the conductor, and protection against electrochemical corrosion as demonstrated by 10,000 hours life test at 83% RH at 28°C on 5 mW load and by elevated temperature tests under electrical loading.

Hybrid realisation of high precision analog conversion modules. L. KUN. *Electrocomp. Sci. Technol.* **5**, 49 (1978). High precision analog modules are manufactured using film

technologies. Components which are critical as regards operation and stability are made by thin film technology, additional elements and interconnection of active components are made using thick film technology.

Using these two separate manufacturing methods to obtain high stability and accuracy, optimum cost and yield can be achieved. To illustrate these facts, two circuits are discussed in detail, a voltage to frequency converter and a log amplifier.

A thick film base metal resistor and compatible hybrid system. F. E. BUZAN, J. D. GRIER, SR, B. E. BERTSCH and H. THORYK. *Electrocomp. Sci. Technol.* **5**, 15 (1978). Non-noble metal thick film materials have been the topic of several recent papers. This paper will focus on the first non-noble metal thick film system comprising conductors, dielectrics and most important, resistors for commercial use. Processing and performance data are presented in detail to illustrate the capabilities of these new materials. Circuit applications information is presented wherever possible. This new class of materials will enable the microelectronics industry to exploit new market opportunities previously unavailable due to the high costs of precious metal materials.