THE ENGINEERING OF MICROELECTRONIC THIN AND THICK FILMS

*The Engineering of
Microelectronic Thin
and Thick Films*

C. E. JOWETT

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Preface

It is often difficult for design and production engineers to decide between thick- and thin-film technologies in the design and fabrication of hybrid integrated circuits.

In the case of thick film, the deposited pattern of conductors, resistors, capacitors and inductors is applied to the substrate by screen-printing and firing special conductive, resistive or dielectric pastes.

Thin-film layers, on the other hand, are deposited in vacuum by evaporation, screen and fire techniques, cathode or ion impact sputtering, chemical or electroless metal deposition, vapour plating and direct writing.

In order to obtain maximum advantages it is necessary for the design and project engineer to be aware of these various technologies.

Thin-film microelectronics is a technology involving configurations possessing high surface-to-surface volume ratios, such as the implementation of large-scale hybrid integrated circuits, using hybrid monolithic LSI chips; this poses the problem of a technological approach, suitable to obtain interconnection networks characterised by high densities with low resistivity conductive lines in multilayer structures, and with low parasitic capacitance at the crossovers.

Although thin-film hybrid microcircuit technology is maturing—new materials and process innovations still continue to cause occasional optimism—more emphasis is being given to economics and applications.

Thin-film circuitry has now been superseded to a large extent by thick-film technology. The rate at which this technology has been accepted into the field of microelectronics has been such that many aspects of miniature circuitry which would otherwise have remained as laboratory curiosities have suddenly become commercially viable; as a result more engineers and designers are exploring the potential of the technology to its limits, resulting in an increased demand to achieve even greater component packing density.

Thin-film circuit processes have been purposely neglected in this book, because of the high capital outlay and the necessary employment of suitably qualified personnel which, for all but large companies, makes the technology an impractical proposition. This, however, may be overcome in the future by continued development and the use of the services of a company specialising in custom design.

The present thick-film systems offer advantages of simple processing, fast and inexpensive tooling systems, economy, using wider tolerance active

devices, higher reliability and multilevel circuit capabilities. As a result, virtually all sectors of today's electrical and electronics engineering are turning to solid-state systems which use thick-film microcircuitry.

To enable designers, production and project engineers to use thick and thin films to the best advantage, this book examines the general engineering aspect, particularly where it will lead to circuit design and production rules different from those that have become common practice with discrete component assemblies.

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Harpندن, 1975

Charles E. Jowett

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