Monolithic Ceramic Capacitors

PLATINUM METAL ELECTRODES IN A FIRED MULTILAYER CONSTRUCTION

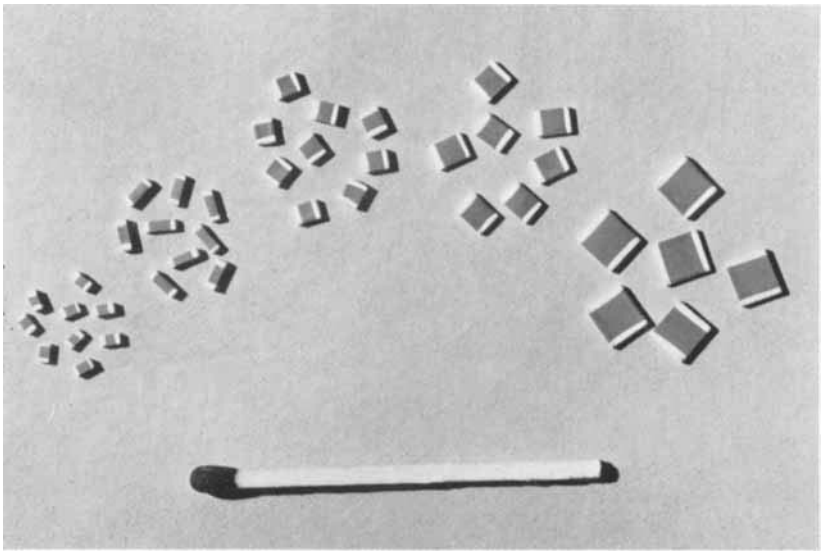
There is a growing use of small monolithic ceramic capacitor chips in integrated hybrid and thick-film circuits. They provide the miniature capacitor elements in resistance/capacitance networks where the resistors may be fired patterns of screen printed resistive inks on an alumina substrate.

The ceramics used normally fall into two categories; "High K" and "NPO". High K capacitors are those based on ceramics of dielectric constants generally in the range 600 to 5000 and provide exceptionally high capacitance per unit volume. NPO capacitors employ ceramics of lower dielectric constant whose chief merit is that of having a temperature coefficient of capacitance very near to zero over a wide operating temperature range.

It has been established over many years now that the platinum metals not only provide the most reliable electrodes in these components but that they also enable an economic production method to be employed. The manufacturing process first entails producing thin strips of "green" ceramic. An ink or paste incorporating finely divided platinum group metals is screen printed on to these strips in multiple arrays of rectangular areas. When the print is dry the strips are assembled one upon the other so that the metallised areas are superimposed. The assembly is topped with plain ceramic, and a light compression bonds the layers together.

The assembly is then diced into individual "chips", each containing one series of superimposed metallic areas interleaved with ceramic dielectric. Fired at 1300°C, these chips become robust monolithic blocks.

Only the use of platinum group metals



Some of the K1200 and NPO monolithic ceramic capacitor chips from Matthey Printed Products Limited. The smallest is 2.4 × 1.3 × 1.3 mm, the largest 9.9 × 10.8 × 1.7 mm, offering in all a capacitance range of 5.6 to 470,000 pF at a peak rating of 100 volts. The terminal areas are metallised to facilitate soft soldering.

makes possible this air-fired, fully integrated construction. The process gives reliable and reproducible results in quantity production and the long-term stability of the components in subsequent service are as good as the ceramics themselves allow.

Matthey Printed Products Limited, of Burslem, have recently announced the introduction of a new range of miniature monolithic ceramic chips. These are their K1200 and NPO series. The type of construction and the choice of ceramic produce chips with a capacitance density of as much as 2.5 μF per cm^3 in the K1200 series, while the NPO series offers chips with a temperature coefficient of capacitance of zero $\pm 30 \times 10^{-6}$ per °C. The rated operating temperature range for these components is -55°C to $+125$°C.

In general, users of monolithic ceramic capacitor chips must be able to connect them into or mount them on integrated hybrid and thick-film circuits quickly and conveniently. For this purpose, the chips are supplied with their terminal ends metallised with silver so that they can be soft soldered with ease.

Conventional capacitors incorporating monolithic ceramic chips are manufactured by soldering wires to the metallised terminal ends and encapsulating the bodies in a synthetic resin that does not affect the properties of the chips but provides protection against humidity.

G. T.

Chemistry of Co-ordination Complexes

The Chemistry of the Rarer Platinum Metals (Os, Ru, Ir and Rh), by W. P. Griffith. Pp. ix and 491. Interscience Publishers, London, New York and Sydney, £6.

To anyone concerned with the chemistry of the platinum group metals the lack of texts on the subject is well known and the publication of any book would be hailed as a noteworthy occasion. The appearance of this authoritative work by Dr Griffith, of Imperial College, is indeed such an occasion. Over the past decade or so a vast amount of work has been carried out on the co-ordination chemistry of osmium, ruthenium, iridium and rhodium and the literature has abounded with the resulting papers. To have now a book containing all the information that has accumulated from the time of the discovery of these metals until the end of 1966 is indeed a great boon.

It is not only to be hoped that the author will continue to cover the literature so that further editions of the book may be as complete as is the present one but that he, or some other person prepared to undertake an equally monumental task, will produce a similar treatise dealing with platinum and palladium.

The book is concerned primarily with the co-ordination chemistry of the four elements and is written in the form of a reference book, much material being presented in tabular form. In the opening chapter such subjects as occurrence, physical, chemical and catalytic properties of the elements, their analytical chemistry and industrial applications are very briefly considered. The following chapter comprises a general chemical survey in which the distinctive features of the chemistry of the elements are outlined. The range of oxidation states and stereochemistries in the metal complexes and the reactivities of the complexes are considered. There is a survey of the physical measurements that have been made with some indication of the chemical information that can be derived from them, and a brief review of the principal ligands found to co-ordinate with the metals. The elements are then dealt with in individual chapters, the co-ordinating ligands being arranged according to the Periodic Group to which the donor atom belongs. Each of the chapters deals comprehensively and critically with the subject, considering in detail molecular structure and the physical and chemical properties of the complexes and concluding with a section on homogeneous catalysis.

This book, if only by reason of its comprehensive coverage, is an invaluable contribution to the literature of the platinum group metals. It makes clear the potential importance of these complexes, particularly in the catalytic field, and should stimulate workers in this branch of chemistry to still greater effort.

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