PREFACE

The anodic oxidation of valve metals is a process of high technical and scientific interest because of its implications in the manufacturing of electrolytic capacitors, in the preparation of passivating layers, in thin film technology and in the growth of protective and decorative films. The immediate objective of much recent work is to identify and study the rate controlling process of oxidation and nature of electrical breakdown and its mechanism.

On anodic polarization of the cell metal/metal-oxide/electrolytic solution/Pt sets a very high electric field strength in the oxide. The practical limit to the maximum thickness of the oxide reached in the anodization process is given by breakdown voltage across the film. Cabrera and Mott, in their single barrier theory of anodic growth of the film, visualize that every ion escaping from the metal is swept right through the oxide and is not an activated process. According to this theory, the Tafel slope is proportional to absolute temperature. Vermilyea like Young observed an agreement with the Cabrera-Mott theory as far as the rate of formation of anodic film was concerned but a complete disagreement regarding the variation of Tafel slope with temperature. Dewald developed a double barrier mechanism for the growth of anodic films.
which takes into account the space-charge contribution. The exact picture of ionic conduction through anodic oxide thin films on metals and the exact nature of the dependence of the Tafel slope is yet to be understood. Since the mechanism suggested by various workers are at variance, therefore, ionic conduction studies over a wide range of temperatures and current densities are required to develop a suitable growth model. The electrical breakdown during the anodization of valve metals is not yet clear due to the interpretation of the processes which arise during breakdown phenomenon. A possible correlation between electronic current and breakdown voltage which could throw a deeper insight into the breakdown mechanism has not received much attention.

Since anodic oxide films are being used in capacitor technology it will be of greater interest to carry out a comprehensive study of the related aspects such as rectification studies, ionic conduction mechanism, current efficiency and effect of current density, concentration of electrolyte, temperature, time and effect of various ions on dielectric properties which will be helpful in obtaining useful dielectric materials.

The aim of our present investigations is to carry out a detailed study of ionic conduction mechanism during
the growth of anodic oxide film on niobium employing various current densities over a wide range of temperature. An attempt has also been made to examine the Ikonopisov's theory of breakdown during anodization aiming to explain the features of the breakdown phenomenon and to study various aspects related to niobium oxide films. Results presented in various Chapters will be useful to the solid state chemists towards ultimately standardizing the technique for capacitor technology and thin insulating film.