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Study about Titanium Electrolytic Capacitor

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This thesis deals with the theoretical as well as the experimental investigations of obtaining the electrolytic capacitor with titanium as an anodic base metal.

Very few informations have been published, concerning with the titanium oxide film of good insulation. The author succeeded in solving the formation problem of the anodic film of good insulation on titanium by using the titanium of high purity, obtained by Kroll method. This new method and used electrolytes were different from those used for anodic formation of tantalum and aluminum. At first, the oxide film with fine anatase type was formed on the surface after immersing in nitric acid solution for a long time as pretreatment. Second, the oxide film was grown uniformly in a short time in the bath of 300°C nitric molten salt electrolyte at applied constant d. c. voltage. It was confirmed that this oxide film with dielectric constant of about 100 had the crystal structure of rutile type. The optimum construction of the oxide film with good electrical properties lays between amorphism and crystal. In order to obtain it, the optimum conditions were derived from the theoretical considerations and experiments on anodic temperature and formation time.

As for the sinter type capacitor, sintered bodies with good electrical properties were formed at the latter stage of surface diffusion at about 800°C.

Experiments on the manganese dioxide coating were performed. On the contrary of the reports, hitherto published, the author pointed out the new facts in case of titanium. The oxide film was damaged by the heating of coating treatment, but regenerated manganese dioxide by reformation, decreased the leakage current of capacitors. The change of capacitance and $\tan \delta$ values of capacitors manufactured by author's process are small in the temperature range of -40°C to 85°C and frequency range of 60 c/s to 10 kC. These electrical properties are more excellent than those of aluminum electrolytic capacitor and almost equal to those of tantalum electrolytic capacitors.

The leakage current of titanium capacitors is somewhat inferior to that of tantalum capacitors, but they cause no inconvenience in practical use. Practical production of the titanium capacitors were verified to be possible as the results of studies and various experiments on anneal effects of titanium metal, vibration formation and utilization of hydrogenize titanium. Structure analysis of the oxide film, which was produced by the heating in atmosphere was performed, which was useful to analyse the oxide film obtained by the electrolytic method.

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