

The Charge Injection Characteristics of Iridium and Iridium Oxide films

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1. Introduction

Iridium is an excellent candidate for use in charge injection electrodes for neural prostheses. Under cyclic polarization in a suitable electrolyte, it undergoes a change in the oxidation state of Ir from +3 to +4 during the anodic part of the cycle. During the cathodic part of the cycle, the reversible change occurs. As a consequence, iridium oxide has a large effective charge injection capability under voltage cycling within potential limits which are less than that required to electrolyze water, and is highly resistant to dissolution in corrosive media. Successful production of stable Ir and Ir oxide films on various substrate now limits the use of this material. Lee et al.⁽¹⁻³⁾ studied the charge injection capability of Ir implanted Ti-6Al-4V. The difficulty in producing required values of charge injection due to the lack of Ir retained in the substrate may be a limitation of this method. Therefore, the e-beam evaporation with ion beam assist was employed in this study to create sufficient Ir at the surface of the substrate to allow the higher charge densities, equivalent to those produced by a bulk Ir.

2. Experimental Methods

Samples of Si wafer and 0.2 mm diameter of Ni-Ti wire were employed for the deposition of Ir. A vapor flux of Ir atoms is generated with an electron beam evaporator, and pure argon or mixed Ar/O₂ ion beam generated from a Mark IITM end-Hall ion gun was used for bombarding the substrate and the growing film. The films were activated in 0.1M H₂SO₄ by a repetitive potential cycling between 0.0 V and 1.45 V versus the standard hydrogen electrode, and then evaluated in saline solution. The samples were characterized by XRD, SEM, EDS, and FT-IR.

3. Results and Discussion

A very considerable enhancement of the charge densities was produced by IBAD-grown Ir film with increasing number of cycles, and the charge injection curves became almost symmetrical with regard charge density about the potential axis, which are very similar to a bulk Ir. SEM observation revealed that the increase in charge density on continuous potential cycling was due to the accumulation of the oxide phase. The efficiency of the oxide growth has been found to be very dependent on the upper and lower limits of the activating potential sweep, and also on the potential

sweep rate as shown in Figure 1.

Figure 1 shows the injectable charge density is related to the oxide film thickness grown on Ir by the activation process. The 'activated' Ir film injected stable charge densities in isotonic saline solution up to 500-cycle, and the long-term stability test is still undergoing.

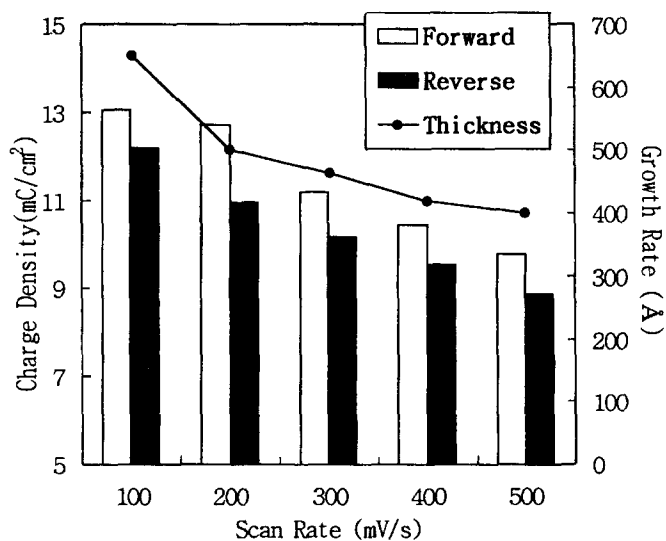


Figure 1. The dependence of injectable charge density on the scan rate

4. References

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