



Contribution ID: 141

Type: **Contributed**

Plasma electrolytic oxidation of niobium in silicate electrolyte

Wednesday 20 June 2018 14:40 (20 minutes)

Porous structures in anodic coatings, such as those formed by plasma electrolytic oxidation (PEO), are potentially favourable for the addition of material that improves the surface properties. The PEO process results in relatively thick ceramic coatings, which are formed in aqueous electrolytes under high voltages that cause formation of microdischarges on the coating due to dielectric breakdown. In this study coatings have been formed on niobium. The coatings are being developed with the purpose of providing coated niobium substrates that can support a magnesium diboride superconducting layer, with several methods of layer production being considered. The present work focuses on the processing conditions required for formation of the PEO coatings, the kinetics of coating formation, and the composition, morphology and structure of the resulting oxide layers. The study employed a silicate electrolyte, a constant rms current density, with a frequency of 50 Hz and a square waveform. A range of negative-to-positive current ratios was used to form the coatings. Voltage-time curves were recorded to monitor the coating growth. The coatings were examined by field emission analytical scanning microscopy and X-ray diffraction. The coatings, which were of thickness in the range 40 to 60 μm , are shown to be highly porous, with a relatively thick, silica-rich outer region and a thinner, niobium-rich inner region. The coatings contained Nb_2O_5 and silicon-rich amorphous material. The rate of coating growth decreased with increasing processing time, associated with a relatively drop in the voltage, and a reduction in the intensity of sparking.

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Session Classification: Surface Science & Applied Surface Science

Track Classification: Surface Science & Applied Surface Science