THE HIE-ISOLDE SUPERCONDUCTING CAVITIES: SURFACE TREATMENT AND NIOBIUM THIN FILM COATING

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BACKGROUND

HE ISOLDE LINAC
An energy upgrade of the HIE-ISOLDE Radioactive ion Beam Facility is planned at CERN for the next 5 years. The upgrade consists of boosting the energy of the machine from 30keV/u to 100keV/u with beams of a mass to charge ratio of 2.5c/rc/4.2 and it is based on superconducting quarter wave resonators (QWRs). OWR & R&D ACTIVITY PROGRAM
For the foreseen upgrade of the ISOLDE complex a new superconducting coil, based on sputtered Nb/ru Quarter Wave Resonators (QWRs) of two different beta families is planned to be installed in the next three to five years. A prototype cavity of the higher beta family is currently being developed. In this paper the latest developments on the sputtering technique for the kind of cavity geometry and the first coil RF measurements are shown.

BIASED MAGNETRON SPUTTERING

Biased Magnetron Sputtering at 0.015 mbar
Calculations were run to simulate the axial magnetic field and optimize the coil heights. A multilayer coil of 1 m diameter, was built. Its dimensions and the number of layers were calculated in order to obtain a magnetic field which is homogeneous, higher than 1000 Gauss and parallel to the cathode, the major part of the magnetron sputtering test and the first cavity coating were performed at 0.015 mbar.

- The magnetic field keeps the plasma stable on the outer side of the cathode,
- inside the cathode, the plasma is extremely enhanced giving rise to and efficient sputtering,
- the cylindrical cathode was surrounded by an external grid but no internal grid was inserted.

Biased Magnetron Sputtering at 0.003 mbar
Several simulations with MOMENT (based on the Monte Carlo method and MC sputtering algorithm) were run to study the coating rate on the internal conductor in response to the bias and the thickness degradation on the tip of the inner conductor is not due to the increasing distance with the cavity, but due to the increasing rate in many limited by collision with the gas atoms. Tests were performed reducing the coating pressure to 0.003 mbar.

RESULTS

Biased Diode Sputtering

Several tests have been performed, with different configurations and parameters. Achieving a uniform coating thickness is possible and it is only limited by the power supply and the coating system. The first cavity was tested in Vancouver. The performance was one order of magnitude lower than expected. The copper substrate proved to be a very good thermal stabilizer even with the highest power pulse we could produce the cavity never quenched and different points of the cavity showed always quite stable temperatures. The problem on the top of the cavity inner conductor was overcome with a change of sputtering parameters and the new coated cavity is ready to be tested. The production of a new copper cavity, dedicated entirely to the coating test, is under way and it will allow to focus directly on the correlation between the coating parameters and the cavity performance.

CONCLUSIONS

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