ACCELERATOR SEMINAR

"Plasma Processing of SRF Cavities"

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The first results of plasma processed Niobium (Nb) SRF cavities using cylindrical coaxial capacitively coupled radio frequency (rf) plasma will be presented. The research was focused on the transition of plasma etching from two dimensional flat surfaces to inner surfaces of three dimensional (3D) structures. The results could be applicable to a variety of inner surface of 3D structures other than the SRF cavities. Understanding the Ar/Cl_2 plasma etching mechanism is crucial for achieving the desired modification of Nb SRF cavities. An apparatus was built and a method was developed to plasma etch a single cell Pill Box cavity. The plasma characterization was done with the help of optical emission spectroscopy. The Nb etch rate at various points of this cavity was measured before processing the SRF cavity. Cylindrical ring-type samples of Nb placed on the inner surface of the outer wall were used to measure the dependence of the process parameters on plasma etching. The measured etch rate dependence on the pressure, rf power, dc bias, temperature, Cl_2 concentration and diameter of the inner electrode was determined. The etch rate mechanism was studied by varying the temperature of the outer wall, the dc bias on the inner electrode and gas conditions. In a coaxial plasma reactor, uniform plasma etching along the cylindrical structure is a challenging task due to depletion of the active radicals along the gas flow direction. The dependence of etch rate uniformity along the cylindrical axis was determined as a function of process parameters. The formation of dc self-biases due to surface area asymmetry in this type of plasma and its variation on the pressure, rf power and gas composition was measured. Enhancing the surface area of inner electrode to reduce the asymmetry was studied by changing the contour of the inner electrode. The optimized contour of the electrode based on these measurements was chosen for SRF cavity processing.

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11:00 a.m.
Applied Research Center, Room 231

Jefferson Lab

For further info, please contact Joe Grames at x7097