Coupled RF Thermal Analysis of High Power Couplers for Accelerator Cavities

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Abstract

High-power couplers working at 350 MHz for particle accelerator cavities are presently under development in the LEHIPA project at BARC. As each coupler will feed more than 50 kW RF power, it becomes important to analyze RF losses on conducting surfaces and resulting thermal profiles. The coupler assemblies also include brazed alumina windows, which are prone to thermal failure because of non linear dielectric heating effects. COMSOL Multiphysics® is used to study these coupled RF-thermal effects and estimate cooling requirements for these couplers. A 3D model of a coaxial coupler is shown in Fig. 1. The input power is fed to the rigid coaxial line of 61/8" EIA standard. As the port size available on the cavity is small, the incoming line is tapered to smaller size of 15/8". The impedance matching is obtained by the taper. A shorted stub of quarter wavelength is also provided to allow water cooling of inner conductors. The power to the cavity is coupled by a loop of suitable area. The loop is made on the 1 5/8" side. However, in this study only the transition part is simulated without a loop. As the cavity side is under vacuum, RF windows of high purity alumina discs are introduced in the line. The RF loss on the copper conductors and dielectric loss on the RF window is modeled using the COMSOL RF Module. This loss is used to calculate the thermal profiles and estimate cooling requirements by using the Heat Transfer Module. The RF loss data from the RF Module is coupled to the COMSOL Heat Transfer Module to carry out parametric studies on temperature profiles for different input power and cooling rates. The results of coupled RF-thermal analysis are reported in this work.

Figures used in the abstract

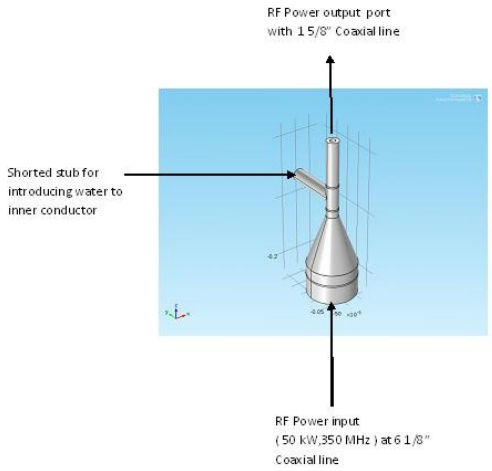

Figure 1: 3D model of coaxial RF coupler