WF-Note 208

On the design of coupling scheme for dielectric loaded standing wave accelerating cavity

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For the old side coupled scheme, the copper residuals on the outer wall of the dielectric tube can cause problem to the coupling effectiveness and even breakdown under high power conditions. These residuals are difficult to avoid during assembling. To avoid this problem, we change the coupling scheme from side couple to axis couple. The axis couple scheme is shown in figure 1.

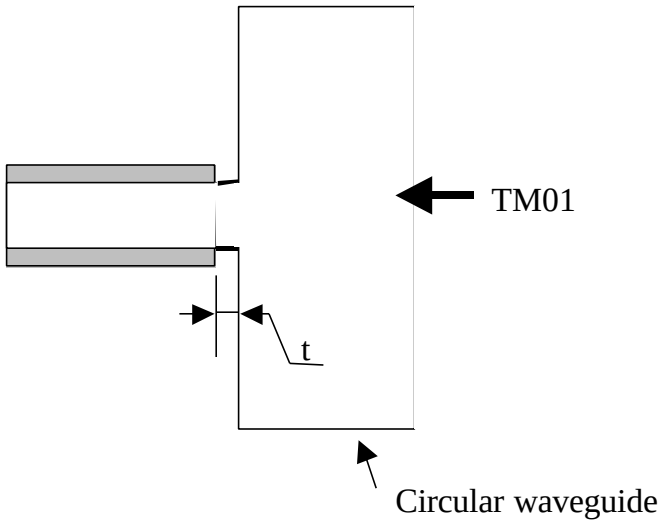

Figure 1. Axis couple scheme

As shown in figure 1, the radius of coupling iris is the same as the inner radius of dielectric tube. We adjust the coupling by changing t, the thickness of the iris. As we known that the coupling parameter could be calculated via

$$b = \frac{Q_0}{Q_{ext}} \qquad (1)$$

where Q_0 is the quality factor of unloaded cavity and Q_{ext} is the quality factor corresponding to the external elements. Q_0 can be easily found by analytical solution or numerical simulation software. In our design process, the Q_0 was calculated via MAFIA[1], a well known EM simulation software. We adopted Kroll-Yu method[2] to find out the Q_{ext}. The input data for Kroll-Yu method were also obtained by MAFIA.

Using the above process, we calculated a 1λ dielectric loaded standing wave X-band accelerating cavity. The dielectric constant is 9.4 here. The working frequency is 11.424 GHz. Q_0 of the cavity is 3560, obtained via MAFIA. The radius of the input circular waveguide is 12.079mm, the same as our TE-TM mode converter. When t=2mm, the Q_{ext} we obtained is about 3400 which means it is almost critical coupled.

A field pattern is also calculated by Microwave studio and given in figure 2. The input

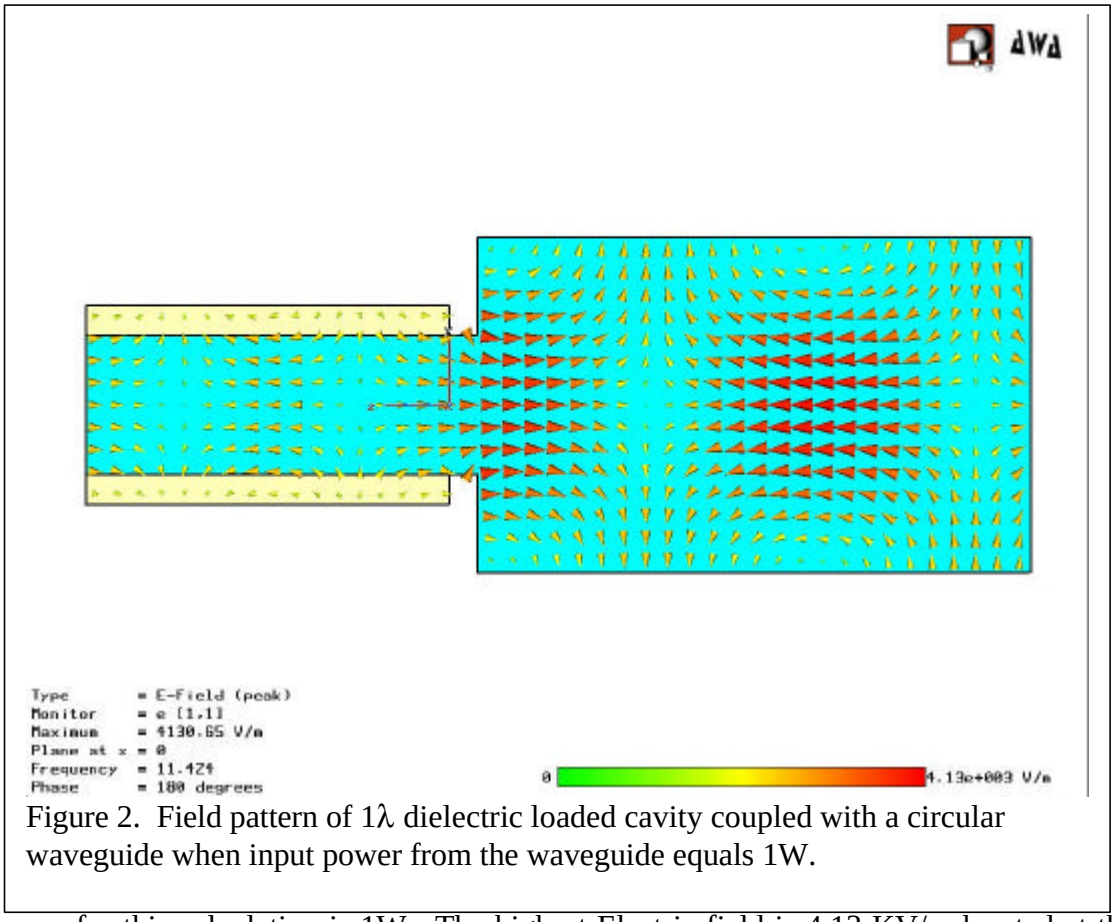

Figure 2. Field pattern of 1λ dielectric loaded cavity coupled with a circular waveguide when input power from the waveguide equals 1W.

power for this calculation is 1W. The highest Electric field is 4.13 KV/m located at the corner of the iris. The accelerating field is about 1.49KV/m.

[1]	MAFIA manual 4.0
[2]	Norman M. Kroll and David U. L. Yu, computer determination of the external Q and resonant frequency of waveguide loaded cavities, Particle Accelerators, Vol 34, pp 231-250