Cold-Test experiment of Curved-Ring-Bar Strcutures for High Power TWT

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High power microwave sources have been used in many applications such as for radars, long range satellite communications systems, particle accelerators and so on. Among these sources, high power Traveling Wave Tube Amplifiers (TWTA) are attractive for several factors. They provide high power, high gain, linearity, wide bandwidth and low loss. As is well-known, high power TWTAs require suitable Slow Wave Structure (SWS) within the tube to slow down electromagnetic wave and therefore enable stronger coupling with electron beam. Several important factors influence the performance of TWTs. Among them are: 1) a suitable Slow Wave Structure (SWS) within the tube, 2) beam focusing, 3) attenuation, 4) electron beam to wave interaction, 6) collector-coupling module, and 7) cooling efficiency. In previous conferences, we presented a Curved Ring Bar slow wave structure for high power TWT for RADAR application. This SWS was capable of coupling with the electron beam even when its wave velocity was as large as 0.77c. Importantly, the interaction impedance of the structure was nearly flat across the entire S-band with minimum value of 45Ω. At this meeting, a number of factors will be considered to address the issues realizing of the SWS. A cold test experiment, dispersion engineering topics along with reflection, interaction with electron beam, support layout will be discussed. Three topics will be discussed as follows:

- A coupled transmission line model of the curved ring bar structure will be presented. In this context, the concept of slow wave propagation using coupled transmission line theory will be revisited.
- Challenges in carrying out a cold test experiment along with experimental setup and measurement calculations will be presented.
- Hot test simulation will be presented to verify the usefulness of the cold test simulation. A prototype model of high power TWTA will be also presented.

The main aspect of the paper is to present cold test experimental data using the Curved Ring Bar to evaluate its performance in high power operation. The dispersion data achieved from the cold test experiment will be compared to simulation. Also, phase velocity and interaction impedance profiles will be used to perform a hot test simulation that verifies the suitability of the structure for high power TWTs. This will be done by using a Slow Wave Structure (SWS) inside the TWT that is based on a ‘Curved Ring-Bar’ to achieve efficient interaction with the electron beam. Finally, hot test simulation using Particle in Cell code will be presented to verify the concept and cold test experiment.