PREFACE

Due to its numerous commercial and military uses, high-power microwave (HPM) has gained immense popularity in the microwave world. Researchers and academics from all over the world are interested in R&D in this field due to the creation of RF in millimeter-wave ranges and the dual-frequency generation using a single HPM device. A HPM source is a device that has a frequency range of 1–300 GHz and can generate RF power more than 100 MW. The major application fields for HPM include indirect energy weapons, communication, radar, UWB, power beaming, linear colliders, and (DEW). Different sub-systems are utilised throughout the whole process of HPM generation and application, starting with the prime power supply and following on through pulsed DC power formation, a microwave source, a mode converter, and an antenna. Each of these several HPM subsystems has a distinct function in the generation and application of RF energy. The primary component of the entire microwave generation process is the microwave or HPM source. A relativistic magnetron, a relativistic klystron, a relativistic backward wave oscillator, a relativistic gyrotron device, a vircator, a reltron, and a magnetically insulated line oscillator are examples of HPM sources that can produce RF power (MILO). Cherenkov radiation, transition radiation, and Bremsstrahlung radiation are the three basic categories used to describe the various radiation processes used by these HPM sources. The HPM source MILO, which employs the Cherenkov radiation process, is the basic foundation of this research. When compared to other HPM sources, the MILO requires no external magnetic field, which makes it compact, lightweight, and suitable for usage on many mobile platforms.

Similar in operation and theory to a linear magnetron, MILO is a crossed-field high power microwave device. Slow-wave tubes and magnetically insulated electron flow technology are combined to make it operate. Two DC power sources are used in a microwave oscillator, which needs an external DC magnetic field, in order to demonstrate magnetic insulation and cause electrical breakdown when higher voltages are approached. Because of their extremely high inherent impedance, these oscillators can only function at very low power levels. Therefore, an oscillator that can function at the lower impedance and solve the voltage matching issue would be appropriate for effective operation at greater power levels. In order to solve the aforementioned issues, MILO has been employed, where the necessary magnetic field is generated by the electron-beam current itself, rather than by a separate magnet, making the device more compact and lightweight. The design of MILO must be improved in order to prevent some serious problems, such as the issue of pulse shortening, asymmetric mode generation and mode competition, shot-to-shot reproducibility, the requirement of high pulse rate frequency, and long cathode life, which are still observed as challenges for device development. The Electromagnetic analysis of partially dielectric filled in SWS of MILO by the use of field matching approach in beam absent case, and also the effect of dielectric material on device parameter are the prime concern for this thesis. Further the electromagnetic analysis of beam wave interaction in partially dielectric filled MILO has been done in this research. The partially dielectric filled MILO was simulated by the CST studio suite and cathode misalignment effect was also analyzed in this thesis.

The author has periodically published parts of the current work in reputed publications, including IEEE Transaction on Plasma Science.

If it proves helpful in the design of partially dielectric filled MILO, the author will consider his little effort a success.