**Transfer of Technology (TOT) for new dielectric lossy composites for high power microwave devices**

1. **Description of the Technology**

The dielectric lossy ceramic composites are essential materials for the high power microwave tubes to suppress background wave oscillations & unwanted signals, instabilities and reduce reflections and improve matching and gain characteristics. Production of BeO-SiC lossy ceramic composites that were used earlier by Microwave Industry is banned due to toxicity & carcinogenety of BeO. The lossy ceramic composites are used for strategic applications hence their Supplies are restricted internationally and are required for various other tubes like TWTs of G, X, Ku band tubes. Hence an alternative lossy ceramic based on AlN-SiC composites are developed through hot pressing process and subjected to various desired thermal, electrical, physical, mechanical properties evaluation. The composite is machined to component size with designed corner tapers, brazed to OFHC copper and assembly was tested for 20 times thermal cycling at 7000 C.

 **2. Application Areas**

The composite materials are immediately required for Sever terminations (50numbers/tube) and low loss buttons (80 numbers/tube) for S-band High Power Microwave tubes of MTRDC for Naval Radars that are being produced at BEL (400 tubes), which has also got further export orders. These are also required for various other tubes like TWTs of G, X, Ku band tubes. Since lossy ceramic composites are required for strategic applications, their Supplies are restricted internationally and the uncertainty of supply will cripple the high power microwave tubes development and production that are essential for radar, electronic warfare applications.

The lossy materials are also used in the high power microwave tubes as sever terminations, absorber buttons, sever wedges, load pellets etc. The demand for the materials is vast as per estimation of CEERI, Pilani in 2006 with requirement of more than 2000 tubes for 10 years for India’s defence requirements. With government liberalization of defence exports, the demands for tubes and necessity of lossy ceramics still going higher for various tube manufacturers in India like MTRDC, DLRL, LRDE, RCI, ISRO, ADA, DEAL and BEL etc. and also abroad.

1. **Its USP-Such as Certifications and test results etc.**

 The DMRL produced composites were fixed in S-band 130 KW high power microwave tube and tested for VSWR response which was found to be satisfactory and equivalent to imported BeO- SiC lossy buttons. The composite properties in comparison to tube needs are shown in table.

|  |  |  |
| --- | --- | --- |
| Property- Sever application | S-band tube Requirement  | DMRL made AlN-SiC Lossy material  |
| Relative permittivity (ε) in S-band  | 25-35  | 40  |
| Dielectric loss (tan δ)  | 0.3-0.6  | 0.4-0.6  |
| Density g/cc  | >3  | 3.28  |
| Thermal Expansion (CTE)  | 5 ppm/K  | 5 ppm/K  |
| Bend Strength, MPa  | 300  | 350  |
| Hardness, GPa  |  13  | 15  |
| Thermal stability  | >10000 C  | 19000 C  |
| Out gassing upto 1300 K  | No  | No-out gassing  |
| Thermal conductivity  | 100 w/m.K  | 55 W/m.K  |