A Novel Multipactor Suppression Method and Application in High-power Antenna Feed System

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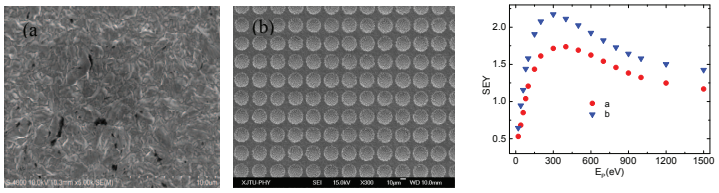
It has been a big challenge that breakdown occurs due to multipactor in the high-power antenna system. When it occurs electrons deposit considerable energy in a tiny spot between metallic walls, leading to power dissipation, electrical performance degradation, surface damage and even ultimate device damages.

A novel approach was proposed which constructed porous structure on the surface of microwave components to reduce the secondary emission yield and improve the discharge threshold. Firstly, emphasis is placed on the multipactor simulation analysis of the secondary emission properties of different finishing conditions. Based on our previous work, an electromagnetic PIC algorithm to force electrons in the predefined hexahedral meshes is established. Combined with the secondary electron emission numerical model, a simulation method of components with porous surface has been implemented. Then, secondary electron emission yield (SEY) measurements of samples with or without porous surface have been made. Finally, the relationship between the microstructure surface and the SEY, and then the multipactor threshold have been constructed successfully.

Simulation results of typical microwave components demonstrate the physical pictures of the development of electron multipacting at certain power level.

For the reduction of SEY, regular porous micro-structure has been constructed on the metal surface. Typical SEY curves of silver with different surface processing condition are shown in fig. 1.



(a) (b) (c)

Fig. 1 Photograph of (a) silver sample, (b) porous structures, (c)measured data

Another challenge lies in the implement of the porous microstructure on the microwave components with relatively large dimension. Through some finishing control process, the regular porous surface has been constructed on the impedance transformer with success ultimately. The component is fabricated and the forward-reverse power nulling detection method is used in either CW or pulse mode for multipactor testing. After structure parameter optimizing through the simulation approach, the simulated thresholds improved from 2219W to 5625W. And experiment results show that the breakdown threshold improved from 2100W to 5500W. The successful implement of this multipactor suppression method makes it promising in the high-power feed network of transceiver antenna systems.