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## Nanostructured surfaces of low-secondary electron emission to prevent multipactor effect in high-power Rf devices in space

There is a great deal of interest in surface treatments of low secondary electron emission to avoid multipactor breakdown in high-power microwave devices for space or electron cloud in large accelerators. The multipactor breakdown is an electron avalanche-like discharge that occurs in components operating under vacuum conditions and high-power microwave electromagnetic fields. The multipactor effect appears when an RF electric field accelerates free electrons inside the device, impacting the metallic walls of the structure. If the kinetic energy of the incident electrons is high enough, secondary electrons can be emitted from the surface thus increasing the electron population until an electron discharge is produced degrading the component performance. The amount of secondary emission depends on factors such as the bulk and surface properties of materials, the energy of incident electrons, and their angle of incidence. It is of great interest to determine the total secondary electron emission yield (SEY), which is defined as the number of secondary electrons emitted per incident primary electron. The goal of our research is to identify novel surface treatments to achieve very low- SEY and, therefore, high-power RF devices without the multipactor discharge. We have developed different surface treatments to reduce the SEY. In particular, nanostructured silver, copper, gold and carbon coatings have been deposited on RF filters. SEY as a function of the primary electron energy has been measured in the DC regime and pulsed mode. In addition, simulations of SEY have been performed. These nanostructured surfaces have been characterized by Auger electron spectroscopy (AES), x-ray photoemission spectroscopy (XPS) and atomic force microscopy (AFM). The results of the SEY measurements of these nanostructured coatings, Fig. 1, have also demonstrated that the surface roughness of high aspect ratio is one of the most important parameters to be optimized to achieve SEY<1.

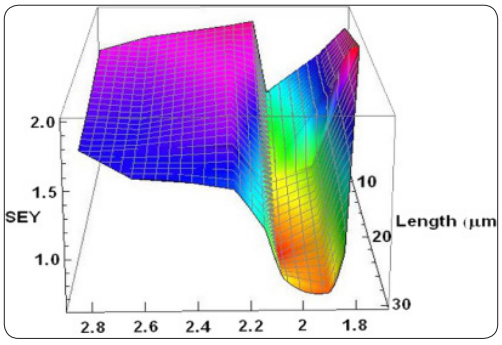


**Figure 1:** SEY maximum as a function of the width and length of gold coated nanowires grown on copper.

## Recent Publications

1. Isabel Montero, Lydya Aguilera, Ulrich Wochner and David Raboso (2016) Anti-Multipactor Device. WO2016042192A1.
2. Isabel Montero et al. (2014) Secondary electron emission under electron bombardment from graphene nanoplatelets. Applied Surface Science. 291:74-77.

3. Cerdá I et al. (2016) Unveiling the pentagonal nature of perfectly aligned single-and double-strand Si nano-ribbons on Ag(110). Nature Communications 7:13076.
4. Bronchalo E et al. (2016) Secondary electron emission of Pt: experimental study and comparison with models in the multipactor energy range. IEEE Transactions on Electron Devices. 63(8):3270-3277.

## Biography

Isabel Montero is head of the research group of "Surface Nanostructured Surfaces for Space and Terrestrial Communications" of the the Spanish National Research Council (CSIC), Madrid, Spain. She is an expert in secondary electron emission under electron bombardment process (SEY) with high experience in also in materials and coatings of low-SEY to avoid multipactor effect and in different methods of surface characterization including synchrotron radiation techniques. She is also the Director of Spanish Laboratory on secondary electron emission of the Materials Science Institute of Madrid of the CSIC, Spain

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