Nanostructured transparent thin films for frequency-selective electromagnetic shielding

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SUMMARY

Transparent electromagnetic shields are used in several industrial sectors. Examples are the displays of video terminals, of electrical and electronic equipment, of electromedical instruments, of portable electronic devices. They can also be exploited in automotive and aerospace applications to prevent the penetration into the craft, through the direct coupling with the windows, of high intensity electromagnetic fields (HIRF) emitted by intentional sources such as radio and TV emitters, radars and satellite communication systems.
During the last two year a research project has been carried out by the electromagnetic compatibility (EMC) and physics optics groups of the University of Rome "La Sapienza", in collaboration with ENEA Research Center, aimed to the design, realization, and characterization of prototypes of lightweight radio frequency EM shields, transparent in the visible range, by exploiting the powerful of nanotechnology. The results of the research have demonstrated that transparent metals, constituted by alternating nano-layers of silver and titanium oxide or zinc oxide, provide EM shielding of 40 dB in the frequency range from about 10 MHz to 6 GHz, and maximum optical transmittance in the visible range of 70 % [1] – [4]. Successively, the feasibility and efficiency of transparent metals for the active shielding of low-frequency magnetic field has been investigated [5].
However, one of the main problems related to the practical application of the new transparent shield for radio frequency on the windows of vehicles is related to the fact that both wanted and unwanted electromagnetic fields are screened. Therefore, cellular communications from the inside to the outside can be inhibited or limited. In order to overcome such a problem, this paper investigates on the feasibility of transparent frequency-selective electromagnetic shields for radio frequency made of nanostructured metallo-dielectric thin films. The shielding and transmission properties of different patch geometries of transparent metals will be investigated and optimized in order to achieve minimum reflection at the frequencies for cellular communication, and maximum shielding out of band at radio frequency.
Sample prototypes will be performed at the Thin Film Laboratory of ENEA Research Center and tested in the EMC Lab of the University of Rome "La Sapienza".

References

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