

PIERS 1998

Progress In Electromagnetics Research Symposium

PROCEEDINGS

Volume 1

July 13-17, 1998
Nantes, France

Organised by
The Electromagnetics Academy
CESBIO, IRESTE, Université de Nantes
CESBIO, CNES-CNRS-Université Paul Sabatier, Toulouse
Institut Universitaire de Technologie, Université de Paris X

Session HO3
Tuesday, July 14, PM 13:40-17:20
Room R02
Composite Material Modeling II
Workshop on Complex Media and Measurement Techniques
Chairs : M^{ac} Phedran, A. Priou

13:40	<i>Effects of a finite screening length on the absorption of electromagnetic waves</i> J.-J. Nia, Service de Physique Nucléaire, CEA, Bruyères le Châtel, France ; R. Balian, Service Physique Théorique, Gif-sur-Yvette, France	364
14:00	<i>Bulk conductivity of two-phase composites with randomly distributed spheroidal inclusions</i> N. Harfield, School of Physical Sci., Dept. of Physics, U. of Surrey, Guilford, Surrey, England	365
14:20	<i>Frequency behavior of percolating systems</i> R. A. Gerhardt, School of Materials Science and Engineering, Georgia Institute of Technology, Atlanta, USA; D. S. McLachlan, Dpt. of Physics, U. of Witwaterstand, Johannesburg, South Africa	366
14:40	<i>Magneto-optical properties of metal-dielectric composites with a periodic microstructure</i> Y. M. Strel'niker, D. J. Bergman, School of Physics and Astronomy, Raymond and Beverly Sackler Faculty of Exact Sci., Tel Aviv U., Tel Aviv, Israel	367
15:00	<i>Propagation characteristics of multiple-scattered polarised light in random media</i> K.I. Hopcraft, B. P. Abilitt, E. Jackeman, P. C. Y. Chang, J. G. Walker, Dpt of Theoretical Mechanics U. of Nottingham, Nottingham ; D. L. Jordan, G. D. Lewis, Defense Research Agency, Malvern Worcester, UK	368
15:20	<i>Coffee Break</i>	
15:40	<i>The design principles and measurement of surface wave absorbing materials</i> F C Smith, Dpt of Electronic Engineering, U. of Hull, HU6 7RX, UK ; S. Y. M. R. Stroobandt, ESAT-TELEMIC, K. U. LEUVEN, Heverlee, Belgium	369
16:00	<i>Reflection properties of magneto-optic grating in comparison with magneto-optic ultrathin films</i> D. Ciprian, K. Postava, J. Pistora, Dpt. of Physics, Technical Univ. Ostrava, Ostrava Poruba, Czech Republic	370
16:20	<i>Fractal Superlattices: A Frequency Domain Approach</i> A.D. Jaggard, Dpt. of Mathematics, Wheaton College, Wheaton, U.S.A ; Dwight L. Jaggard, Moore School of Electrical Engineering, Complex Media Laboratory, U. of Pennsylvania, Philadelphia, USA.	371
16:40	<i>Remote characterization of fractal superlattices using wavelets</i> Herve Aubert, Ecole Nationale Supérieure d'Electrotechnique, d'Electronique, d'Informatique et d'Hydraulique, Institut National Polytechnique, Toulouse, France; Dwight L. Jaggard, Complex Media Laboratory, Moore School of Electrical Engineering, School of Engineering and Applied Science, Philadelphia, USA.	372
17:00	<i>Group theoretical approach to complex and composite media description</i> V. Dmitriev, U. Federal of Para, Belem-PA, Brazil	373

The Design Principles and Measurement of Surface Wave Absorbing Materials

F C Smith

Department of Electronic Engineering, University of Hull,
Hull, HU6 7RX, UK
Email : F.C.Smith@e-eng.hull.ac.uk

S Y M R Stroobandt

ESAT-TELEMIC, K.U.Leuven,
Kard. Mercierlaan 94, B-3001 Heverlee, Belgium

Surface waves are waves which propagate along an interface of two different media without radiation [1]. Surface wave absorbing materials are used to reduce and redirect the power scattered by several classes of scatterer. The perfect electrical conductor (PEC) half-plane shown in Figure 1 is a generic scatterer which will be used to illustrate the theoretical and experimental techniques necessary for the development of optimized surface wave materials.

The PEC half-plane in Figure 1 is coated with a surface wave absorbing material and is illuminated by a TEM wave at near grazing incidence. The diffracted power at the principal discontinuity is reduced through absorption of the propagating surface wave mode; usually the fundamental electric mode. From a scattering viewpoint, the magnetic mode is often less important to grazing incidence TEM incident waves. The material properties of the surface wave absorber are chosen to optimise power absorption in one or more of the electric modes. However, for absorption to take place it is necessary for energy in the incident wave (normally a TEM wave) to be converted into the propagating surface wave mode. For the treated planar edge in Figure 1, mode conversion takes place at the discontinuity between the absorber and the half-plane closest to the source. The mode conversion site is a second discontinuity which can contribute to the power scattered by the treated half-plane. Surface wave absorption, mode conversion and diffraction at the two discontinuities all impinge on the design of surface wave absorbers. There are also secondary effects associated with half-plane scattering which affect further the performance of the absorber. Planewave absorbers are guaranteed to reduced scattering from planewave sources: no similar guarantee applies to the use of surface wave absorbing materials.

In [2], the authors introduced a new technique for characterizing the propagation properties of planar surface waves. This technique is extended to characterize multi-layer surface wave absorbers. Theoretical analysis of the design constraints described above is combined with the experimental technique described in [2] to investigate scattering reduction through the use of surface wave methods. Other techniques for reducing half-plane diffraction are also considered in the light of the surface wave results.

References

- [1] H.M.Barlow, J Brown, 'Radio Surface Waves', Oxford University Press, 1962, p 5
- [2] S.Y.M.R. Stroobandt, F.C. Smith, 'Method for Measuring the Attenuation and Phase Constants of a Surface Wave Propagating Along an Infinite Plane', Electronics Letters, Vol. 33, No. 20, September 1997, p 1685

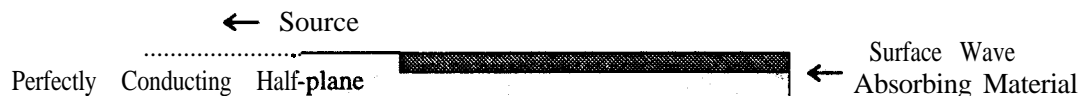


Figure 1 : A PEC half-plane treated with a surface wave absorber. The PEC half-plane is cause of unwanted scattering in several areas including antennas and RCS.