ELS-XV-2015 Abstracts
ELS-XV-2015-23
Electromagnetic & Light Scattering XV 2015, Leipzig

Near-field and far-field analyses of evanescent wave scattering by particles on a surface

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Analysis of electromagnetic scattering of evanescent waves by subwavelength sized particles on a surface is challenging both from the experimental and modelling point of view. Measurements of amplitudes and phases of the waves in both far and near field are almost out of reach with light and nanoparticles. As for simulations, they are particularly arduous mainly because of the multiple reflections induced by the substrate.

This talk will present the most recent results obtained by our device called the surface wave scattering – microwave scanner (SWS-MS). Operating at frequencies in the GHz range, the particles under investigation can have millimeter to centimeter sizes (comparable to the wavelength, down to several tenths of it), and measurements of the amplitude and phase of the fields can be made with small probes close to the particles and with regular horn antennas far from them. Evanescent waves are generated by total internal reflection using a prism. Both transverse electric and transverse magnetic polarizations can be generated and analyzed. Improvements of the prototype version of the device will be briefly introduced.

The cases of a single cube and of a pair of cubes are investigated to determine the detection and resolution limit of the device. The size of the cubes and their separation distance are varied. Measurements in the near field allow observing the modes for a single cube, the impact of the substrate and the modifications caused by the presence of another cube. The exact same configurations are simulated using a Discrete Dipole Approximation code (ADDA) and a Finite Element Method implemented in our lab. They provide insights into the mechanisms involved when dealing with evanescent wave illuminations of particles on a surface.

The potential of this patented system is also investigated directly in the microwave regime through a maturation project with a financial support from SATT Sud Est because the evanescent waves are of real interest for non-destructive evaluation.