



Theoretical Issues and Practical Aspects of Metamaterial Characterisation: Parameter Measurements, Extraction & Interpretation

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Parameters to be Determined?

- ❖ Refractive index
 - ❖ Permittivity & permeability
 - ❖ Phase, group, energy velocity
 - ❖ Impedance
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- ✓ What dictates the choice of parameters?
 - ✓ What parameters are measurable directly?
 - ✓ What parameters are fundamental?
 - ✓ The derived parameters: how do we use them?

Measured Quantities & Techniques

- ❖ Reflectance & Transmittance (Scattering)
 - Free-field/Quasi-optical methods/Ellipsometry
 - Waveguide/Transmission line methods
 - On-wafer probing
- ❖ Resonance Frequency & Q-factor
 - Resonator technique
 - Interferometry
- ❖ Field amplitude
 - Time-domain Spectroscopy (THz & optics)
 - Probing field distributions

Measured Quantities & Constitutive Parameters

- ❖ Interpretational models
- ❖ Models' Applicability
- ❖ “Effective” parameters – what do they mean?
- ❖ Phenomenological parameters
- ❖ Parameter retrieval for complex media:
 - Anisotropic
 - Inhomogeneous
 - Discontinuous interfaces
- ❖ Instrument specimen interference

What can we do?

- ❖ Agree on terminology
- ❖ Define common language
- ❖ Respect the limits of the models' validity
- ❖ Develop the simulation models for the realistic measurement setups

Ideas & Suggestions