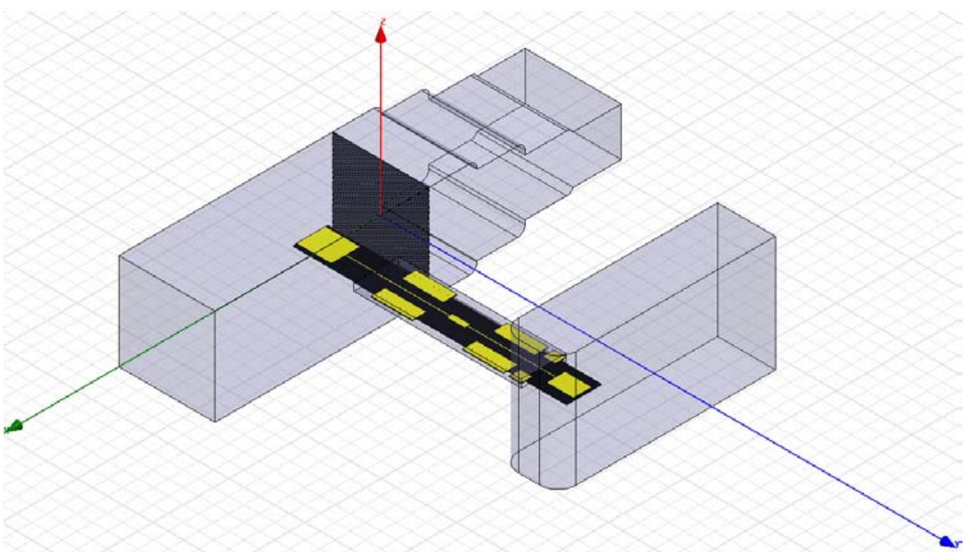
A 600 GHz Orthomode Transducer based on a Waveguide Integrated Wire Grid Polarizer

A. Hammar[1,2*], P. Sobis[1], V. Drakinskiy[2], H. Zhao[2], J. Stake[2], A. Emrich[1]
1 Omnisys Instrument AB, Västra Frölunda, SE-42130, Sweden
2 Terahertz and Millimetre Wave Laboratory, Department of Microtechnology and Nanoscience, Chalmers University of Technology, SE-41296 Göteborg, Sweden
* Contact: ah@omnisys.se, phone +4670 488 2185

***Abstract* — We present a new type of orthomode transducer (OMT), involving the integration of a quasi-optical component, namely a wire grid polarizer (WGP), with an E-plane probe transition, in a waveguide topology. The goal has been to create a lightweight and compact device for waveguide integration, capable of covering all frequency channels to be used by the FIRE instrument¤.**

The design consists of a metallic split block, in which a quadratic waveguide supporting the two fundamental modes of propagation (TE_{10} and TE_{01}), is formed using regular CNC milling. Just as its quasi-optical counterpart, i.e. a free standing WGP, a waveguide integrated WGP insert is used to separate the two orthogonal TE modes, which are either reflected or transmitted (depending on polarization). A planar E-plane waveguide probe transition realized on a GaAs membrane is used inside a square waveguide to extract the reflected mode without affecting the transmitted mode. For a first proof of concept the OMT has been designed for the possibility of full characterization and therefore the transmitted mode is guided through a stepped impedance transformer to a standard rectangular waveguide interface, while a second E-plane probe transition to a rectangular waveguide, is used for the reflected mode.

Simulations carried out using Ansoft HFSS show that the OMT design can be made relatively broadband (currently about ~14% with a return loss better than 15 dBs) and with cross-polarizations better than 30 dB. The probe and WGP can be manufactured using high precision photolithography or E-beam lithography making it scalable to both lower and higher frequency bands. Assembling an OMT of this type involves mounting of small membrane structures (< 1 mm) into waveguides and the design can thus be subject to misalignment errors which may degrade the performance. Hence, a tolerance analysis identifying the most sensitive parameters will be presented together with the different design trade-offs. Practical aspects regarding the assembly of the waveguide probe and WGP into the block will also be presented along with S-parameters measurements. It is the belief of the authors that this new type of OMT concept will allow for broadband operation with relative low losses at high frequencies (i.e. above 600 GHz), where regular WGPs so far has been the most common way to separate two signals of orthogonal polarizations.



¤ A. Emrich et.al. – The FIRE instrument, to be presented at ISSTT 2012