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Tesis: **"TERAHERTZ QUASI-OPTICAL DEVICES FABRICATED BY 3D PRINTING"**

Resumen:

In this thesis we theoretically and experimentally demonstrate four novel devices working at the THz range. We present the first 3D printed GRIN lens. Our measurements demonstrate how these lenses operate within the diffraction limit no matter what the polarization is, at least for the frequencies below 800 GHz ($\lambda > 375\mu m$). We also investigate the chromatic aberration. This new kind of lens shows some advantages compared with the conventional spherical lenses, given that they are thin and flat on both faces and their focal distances can be tailored by controlling the refractive index gradient. In chapter 4 We experimentally demonstrate a novel 3D printed quasi-wollaston prism. The prism uses the birefringence induced in a sub-wavelength layered plastic-air structure that produces refraction in different directions for different polarizations. The component was simulated using the finite-difference-time-domain method, fabricated by 3D printing and subsequently tested by terahertz time-domain spectroscopy showing a polarization separation around of 23° for frequencies below 400 GHz, exhibiting cross polarization power extinction ratios better than 1.6×10^{-3} at 200 GHz. Chapter 5 is dedicated to the examination of, as the best of our knowledge, the first 3D printed q-plate with continuous birefringence variation for the generation of cylindrical vector beams at terahertz frequencies. This device can be used to efficiently couple terahertz radiation into waveguides, where they used segmented waveplates to generate radially polarized beams. Furthermore, other q-plates can be fabricated at low cost for the generation of complex-structured vector beams in order to study physical phenomena of interest in singular optics, such as angular momentum and polarization topologies. Finally in chapter 6 we demonstrate a stepped-refractive- index convergent lens made of a parallel stack of metallic plates for terahertz frequencies based on artificial dielectrics. The lens consist of a non-uniformly spaced stack of metallic plates, forming a mirror-symmetric array of parallel-plate waveguides (PPWGs). The operation of the device is based on the TE1 mode of the PPWG. By varying the spacing between the plates, we can modify the local refractive index of the structure in every individual PPWG that constitutes the lens producing a stepped refractive index profile across the multi stack structure. These results show that this structure is capable of focusing a 1 cm diameter beam to a line focus of less than 4mm for the design frequency of 0.18 THz. This structure shows that this artificial-dielectric concept is an important technology for the fabrication of next generation terahertz devices.