Sub-THz Photonic Crystal Devices

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Photonic Crystal (PC) based devices at mm-Wave and THz frequencies are attractive for future high performance applications in sensing, communications and radar. Within our research we have studied a variety of components that it is possible to create using photonic crystals technology between 75-125GHz, these include: filters [1], waveguides [2], and switches [2].

The PCs are fabricated from a 525 µm high resistivity silicon (>10 kΩ·cm) substrate with a periodic triangular lattice of air holes with a radius of 235 µm and lattice constant of 780 µm. This structure gives rise to a bandgap that extends from 97 – 127 GHz. To create devices defects are introduced into the lattice, a waveguide is a simply a line defect and then filters are made through creation of cavity within the structure by removing several holes. To create a switch the waveguide defect is illuminated by a laser [2], giving rise an extinction ratio of 40 dB demonstrated experimentally. These fundamental devices form the starting point for investigations to realize monolithic integrated photonic crystal architectures.

References

[1] W. J. Otter, S. M. Hanham, N. Klein, S. Lucyszyn, Photonic Crystal Band Reject and Band Pass Filters, MPNS COST Action Training School – MP1204, Cortona, May 2013

[2] W. J. Otter, S. M. Hanham, E. Episkopou, Y. Zhou, N. Klein, A. S. Holmes, S. Lucyszyn, Photoconductive Photonic Crystal Switches, 38th International Conference on Infrared, Millimeter and Terahertz Waves (IRMMW-THz 2013), Mainz, Sep. 2013