ARO Progress Reports

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Long-Term Analog-to-Digital Conversion Development by Short-Term Photonic Crystal Development

FINAL REPORT TITLE
Long-Term Analog-to-Digital Conversion Development by Short-Term Photonic Crystal Developement

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The views opinions and / or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by the documentation.

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13. ABSTRACT (Maximum 13 lines, use the attachment if necessary)
A photonic crystal (PC) design methodology employing long-wavelength infrared sources and analysis systems has been developed. The long-term goal of this research is to develop a methodology that can now be applied to the development of truly dense integrated photonic circuits and systems (DIPCS). Individual components that can be develop include resonators, antennas, sensors, multiplexors, filters, couplers, and switches. Micron-scale photonic crystal structures can now be designed and fabricated using standard microelectronics technology. The fabricated structures are characterized using a Fourier Transform Infrared (FTIR) microspectroscopy system and a discretely tunable carbon dioxide laser system by measuring the transmittance or reflectance of the structure to a focused infrared beam. The focused beam, consisting of infrared light incident over a range of angles, is modeled so that the single-angle plane-wave transmittances or reflectances can be computed from the multiple-incident-angle measurements. The methodology has been demonstrated and the single-angle plane-wave transmittances and reflectances calculated from composite multiple-angle measurements have been shown to be in excellent agreement with theory. The single-angle plane-wave performance characteristic can be used to relate measured device performance to changes in the design and fabrication of the devices. Results obtained at the infrared wavelengths can now be applied to devices that operate at telecommunications wavelengths through the scaling property of photonic crystals.

14. SUBJECT TERMS
photonic crystals

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(Continuation Sheet)

List of papers submitted or published that cite ARO support during this reporting period. List the papers, including journal references, in the following categories:

Number of Peer Reviewed Papers: 1

(a) Papers published in peer-reviewed journals (N/A for none)
T. K. Gaylord and G. R. Kilby, "Optical single-angle plane-wave transmittances/reflectances from Schwarzschild-objective variable-angle measurements," Rev. Sci. Instr., vol. 75, pp. 317-323, Feb. 2004.

Number of Non Peer Reviewed Papers: 3

(b) Papers published in non-peer-reviewed journals or in conference proceedings (N/A for none)
G. R. Kilby and T. K. Gaylord, "FTIR characterization of scaled-up photonic crystal structures," (Abstract) Optical Society of America Annual Meeting Program, TuE6, Oct. 2003.
G. R. Kilby and T. K. Gaylord, "Characterization of scaled-up photonic crystal structures using a discretely tunable carbon-dioxide laser," (Abstract) Optical Society of America Annual Meeting Program, FME3, Oct. 2004.
G. R. Kilby and T. K. Gaylord, "Infrared optical transmission of one-dimensional photonic crystal structures," (Abstract) Optical Society of America Annual Meeting Program, FTuQ2, Oct. 2005.

Number of Papers not Published: 0

(c) Papers presented at meetings, but not published in conference proceedings (N/A for none)

Number of Manuscripts: 3

(d) Manuscripts submitted, but not published (N/A for none)
G. R. Kilby and T. K. Gaylord, "Single-angle plane-wave transmittances/reflectances of photonic crystal structures from composite, variable-angle measurement," Applied Optics.
G. R. Kilby and T. K. Gaylord, "FTIR transmission microspectroscopy of 1-dimensional photonic crystal structures, Optics Letters.
G. R. Kilby and T. K. Gaylord, "Spectral characterization of photonic crystal structures using a discretely tunable carbon dioxide laser system," Review of Scientific Instruments.

Number of Books: 0

(d) Books (N/A for none)

Inventions	Inventors
Photo-masks for wafer-scale fabrication of one-, two-, and three-dimensional photonic crystal devices Georgia Tech Record of Invention No. 3800 US: N, Foreign: N Countries:	,

Sub Contractors:

Graduate Students

Gregory R. Kilby (full time Army officer)

Faculty	
Thomas K. Gaylord, Georgia Institute of Technology	0.10
Barry L. Shoop, United States Military Academy	
TOTAL PERCENT: 0.1	

Post Doctorates

Under Graduates	
Sergio Piega	0.25
Andrew Heidt	0.25
TOTAL PERCENT: 0.5	

Other Research Staff

PHDs awarded
Gregory Kilby

Masters Awarded

U.S. Army Research Office