

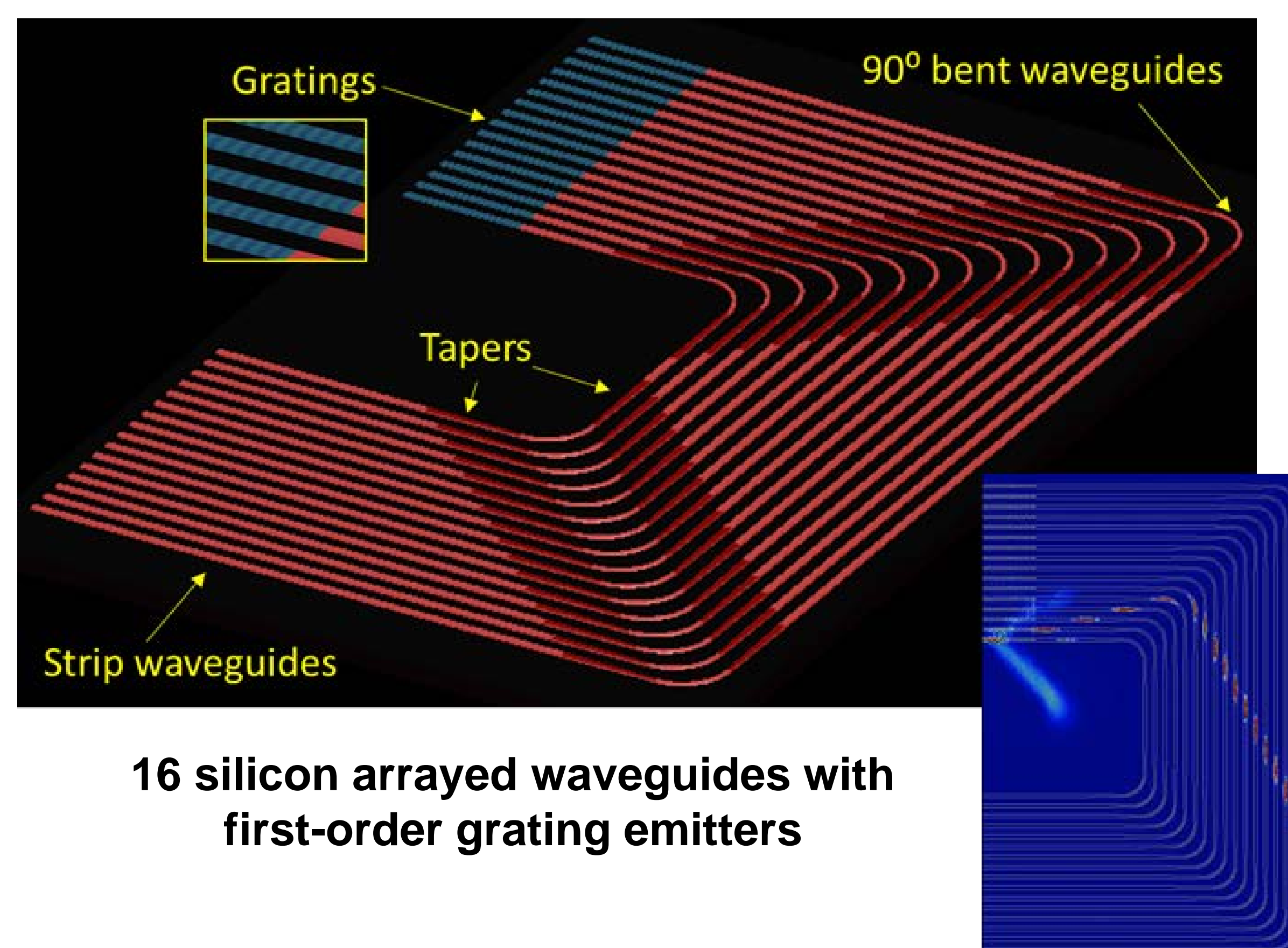
S&T Campaign: Materials Research
Photonics
Imaging Sensors and Optics
Chemical Specific Sensing

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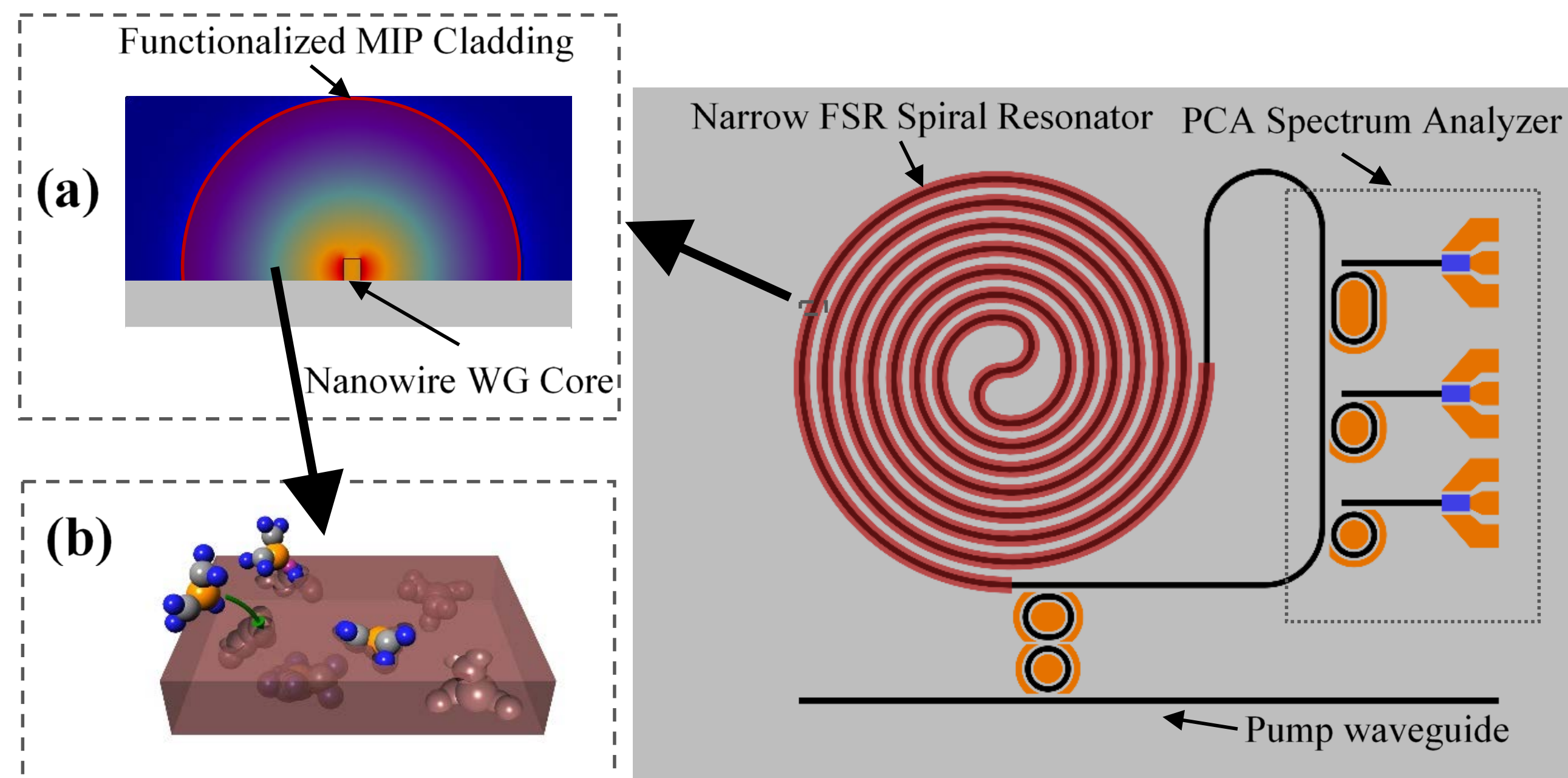
Research Objectives

- Investigate photonic integrated circuits (PICs) for chemical specific sensing, laser ranging and imaging, and free-space optical (FSO) communications
 - Develop an optical phased array (OPA) technology to supplement passive cameras and RF communications on micro-UAVs
 - Improve sensor specificity by direct (i.e., spectroscopic) detection and incorporate polymer-based selectivity onto an integrated photonics platform for increased hazard sensing
- Integrated photonics allow for a significantly lighter and smaller (chip scale) solution compared to bulk optics or RF systems with similar capability

Concept OPA on a micro-UAV



16 silicon arrayed waveguides with first-order grating emitters



Concept drawing of resonantly-enhanced Raman spectroscopic sensor; (a) Cross section and mode profile of nanowire waveguide with MIP cladding; (b) Selective MIP binding accepts molecules corresponding to the spatial configuration of the imprinted template

Challenges

- While fabrication of near-infrared (NIR) PIC components is well understood, the arrangement of and composition of PIC components working together as an OPA system is not
- Developing and integrating molecularly imprinted polymers (MIPs) as a material for PIC devices
- On-chip optical spectrum signal processing
 - Background scattering from non-ideal effects (e.g., waveguide crosstalk)

ARL Facilities and Capabilities Available to Support Collaborative Research

- Specialty Electronics Materials and Sensors Cleanroom (SEMASC) Facility
- Electro-Optic and Acoustic Remote Sensing Laboratory
- Applied Laser Spectroscopy Laboratory
- Multidisciplinary team of researchers, including engineers, physicists, and chemists, with experience in integrated photonics, spectroscopy, MIPs, and chemical sensing

Complementary Expertise / Facilities / Capabilities Sought in Collaboration

- Expertise in PIC device simulation, fabrication, and characterization, including on-chip processing, layout, mounting, and device cooling for one, two, and three dimensional PICs