On-Chip Delay Circuitry

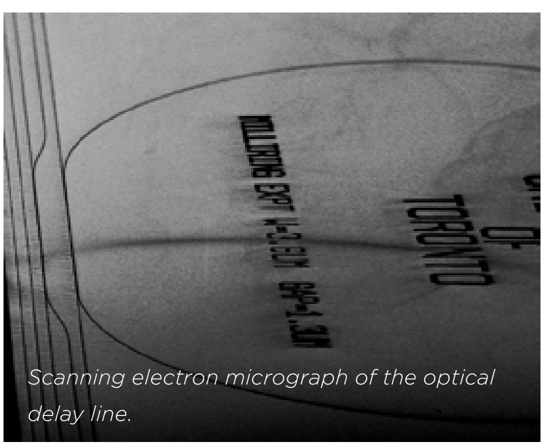
ECTI Collaboration Produces "Dumb Slow Light"

Dr. Alan D. Bristow aligning a delay line experiment.

Interdepartmental collaboration at the University of Toronto, in conjunction with Professor Art Smirl at the University of Iowa, has produced on-chip structures in the ECTI facilities that address many of the research goals sought in the recent worldwide drive to obtain slow-light for improved optical information technology and nonlinear optics applications.

The University of Toronto collaborators include Professor Stewart Aitchison from the Department of Electrical and Computer Engineering as well as Professors Henry Van Driel and John Sipe from the Department of Physics. The team brings semiconductor fabrication, optical experimental expertise and theoretical understanding to the non-trivial problem of using long waveguides and nonlinear directional couplers in an on-chip A1GaAs environment. Typical structures include a 16 mm delay racetrack that adds approximately 100 pulse-delays (bit-delays) to the path length of a 2 ps packet of light. Such systems can be envisaged as optical buffers for storing data packets prior to future optical processing.

The samples used in the experiments were fabricated using photolithography and ICP etching in the Bahen Centre cleanroom facility by Mr. Rajiv Iyer (PhD Candidate, University of Toronto) and Dr. Alan D. Bristow (Postdoctoral Fellow, University of Toronto). Subsequently, the structures were investigated using a pulsed optical parametric amplifier operating at telecommunications wavelengths resulting in all-optical switching at bandwidths of at least 5 GHz. By correctly engineering the waveguide parameters and the nonlinear optical switching, the first step is marked for structures that could potentially operate at bit-rates many times higher.



Scanning electron micrograph of the optical delay line.

The ultimate goal of the project is to obtain structures that not only have a coarse fixed delay, as demonstrated to date, but also to have finely tunable delays many times greater than the pulse-width of the data packets. In doing this the fundamental industrial system requirements for both optical buffering and resynchronization of optical data packets can be achieved on-chip in a single device.

For further information on this research, please contact Professor Henry Van Driel at vandriel@physics.utoronto.ca.