High repetition rate femtosecond laser writing of waveguide devices in bulk glass

Dr Shane Eaton
(Politecnico di Milano)

Talk abstract: By harnessing the extreme intensities provided by focused ultrashort femtosecond laser pulses, light may be nonlinearly absorbed through multiphoton absorption to deposit energy and modify a micrometer-sized volume beneath the surface of transparent glass. This modification near the focus of the laser beam causes a permanent increase in the refractive index of the glass, and by scanning the glass sample relative to the focused laser, optical waveguides may be formed along arbitrary three-dimensional pathways. Optical waveguides are the optical analog of electric circuit paths and confine light for performing optical functions for applications in telecommunications, sensing and labs-on-a-chip for biology. In this talk, the role of the frequency of the incident laser pulses (repetition rate) is studied for the first time, to gain insight into the laser modification physics, particularly at high repetition rates (>1 MHz). At such high repetition rates, the time between laser pulses is shorter than the time for heat from the absorbed laser radiation to diffuse away, causing a buildup of heat which melts within the focal volume. As more laser pulses are absorbed, this melt expands in volume, giving the designer the flexibility to easily control the final size and refractive index change of the optical waveguides. Using repetition rate as an exposure variable for the first time, the lowest transmission loss and maximum refractive index increase were demonstrated in glasses, showing excellent promise for adoption in industrial applications.

Speaker biography: Shane Eaton received the B.A.Sc. degree in engineering physics from the University of British Columbia in 2002, and the Ph.D. degree in electrical engineering from the University of Toronto in 2008. During his undergraduate work, he held co-operative job placements at several Canadian high-tech companies including Nortel Networks, Ballard Fuel Cells and the TRIUMF particle accelerator. In his Ph.D. work, he studied the effect of repetition rate on thermal diffusion and heat accumulation during femtosecond laser microfabrication of optical circuits in glasses for applications in telecommunications and sensing. He is currently a Postdoctoral Researcher in the department of Physics at Politecnico di Milano, where he is studying femtosecond laser writing of optical chips in polymers for biosensing. He is the author or coauthor of 20 journal papers and 45 conference proceedings and is a regular referee for OSA and IEEE journals.