Novel fibre devices for high-speed photonic processing and network applications

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The successful future implementation of high speed optical networks and optical processing schemes is dependent on the continued development of a wide range of high performance optoelectronic devices and subsystems. In this presentation we review recent advances in the development of fibre based components that could prove attractive for use in future all-optical processing systems.

The development of materials with large, fast optical nonlinearities is of great interest for many all-optical processing schemes. We describe recent progress at the ORC in the development of glass/fibre devices with increased (relative to conventional silica fibre) optical nonlinearities and which should allow for the fabrication of compact nonlinear fibre devices. In addition, we report the discovery of a new, massive optical nonlinearity associated with reflection from certain liquefying metal surfaces. The nonlinearity is fully compatible with optical fibre technology and has been used to demonstrate fully fiberised, broadband optical switches and gates operating at milliwatt switching powers.

Chromatic dispersion is another critical factor in any high speed system exploiting ultrashort optical pulses. We review our latest results on the fabrication, characterisation and use of dispersion varying fibre. The applications of this technology include high bit-rate pulse generation, ultrashort pulse compression, transmission and switching.

Fibre Bragg Grating fabrication technology has developed to the extent that precise, arbitrary control of the grating modulation depth and period/phase can be achieved along grating lengths of order 1m. The control of the grating reflectivity amplitude and phase that this offers opens the way to a whole range of possibilities for optical processing and control of ultrashort pulses including pattern encoding and recognition. Moreover, the nonlinear response of the medium allows for unique opportunities for al-optical switching and logic. We review our recent activities in the area.

Finally, we describe recent developments in the area of high power fibre lasers and amplifiers which have opened the way to compact active fibre systems capable of delivering many Watts of output powers. These high power sources make practical the use of nonlinear effects such as Raman scattering for distributed amplification and signal processing leading to additional options and possibilities in the design of high speed optical systems.