EDWA gains on EDFAs

An ion exchange manufacturing process boosts performance and cuts the cost of planar waveguide solutions for metro and access amplification.

The optical metro market has been waiting for ultra-compact, cost-effective optical amplifiers which meet current performance demands of metro and core/access networks. Now, these devices may be realised by advances in erbium-doped waveguide amplifier technology.

EDWAs can overcome system gain limitations and component/sub-assembly losses by combining the properties of an erbium gain medium of low noise figure, absence of inter-channel cross-talk for multi-wavelength applications, and bit-rate transparency above 2.56Gbit/s. Now, EDWAs can offer this high performance while also coming closer to the cost-per-port needed for next-gen systems.

EDWA technology fundamentals

EDWAs consists of two main building blocks: (i) an active waveguide embedded in an amorphous erbium-doped glass substrate; and (ii) a passive chip.

Erbium ions added to the glass then the closer they become, increasing ion-cluster formation. When brought to an excitation state these clusters exchange energy, reducing their efficiency. Despite this, extensive R&D has successfully optimised the erbium doping levels in the waveguide, resulting in a significant increase in the waveguide’s efficiency.

Once the substrate is prepared with erbium, to isolate active areas (to produce channels or waveguides) the active waveguide structure is first formed then buried a few microns below the glass surface to optimise optical stability and performance (Fig.1). A key advantage is the waveguide’s ability to support confined transmission modes with low insertion loss (IL) and polarisation dependence gain (PDS) while maintaining compatibility with fibre interfaces.

The active waveguide is critical to optical gain, but the passive waveguide is equally important in metro EDWA design since it provides high levels of component integration. It’s importance in the final optical design cannot be underestimated. It provides the necessary functionality of a pump signal combiner, a remnant pump optical filter and input/output monitor taps for signal monitoring of 1-port and 4-port EDWAs. The benefit is the elimination of fibre splices, offering lower manufacturing cost, lower intrinsic IL, higher reliability and space savings (by eliminating fibre routing).

Metro EDWA

An example of the advances in EDWAs is Teem’s Metro EDWA amplifier series. Three versions (single-channel, narrowband, and DWDM) offer optical gain improvements due to recent R&D and manufacturing improvements.

An uncooled pump laser consumes four times less power than the earlier TEC version. Combining this with an NF of 6dB allows greater freedom in system placement and the maximum acceptable single-to-noise ratio.

Through integration of active and passive waveguides as well as the Mini-DIL LD pump - the EDWA functions as an active gain block. But by adding optional gain flattening and gain or power control electronics, it can function as a broad-band optical amplifier.

Also, we have designed a multi-port EDWA for high optical performance over several compact waveguide structures. The fully integrated 4-port optical amplifier array - an industry first — offers 10dBm output per port with similar advantages to the single port, such as Multi-DIL LD pump, low NF and high bit-rate transparency.

By using this integration for more compact and economic devices, the multi-port EDWA should enable greater optical integration, effectively removing the losses inherent in narrow-band components/sub-assembly.

Teem believes that the integrated EDWA offers performance comparable with an EDFA, but with a smaller footprint and a lower cost.