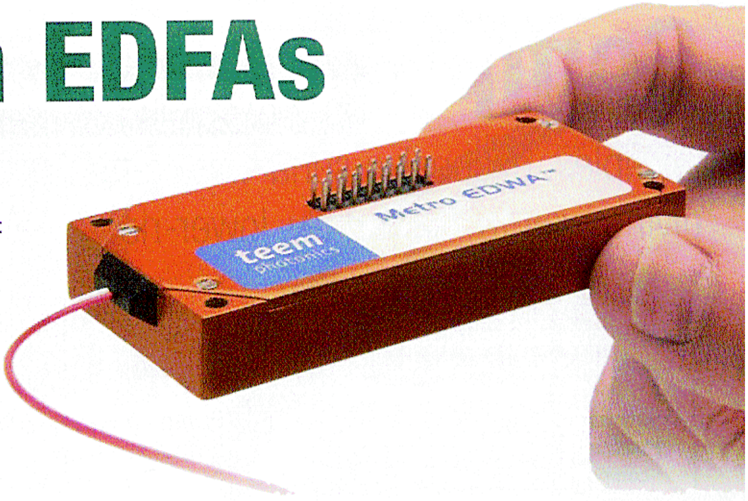
EDWA gains on EDFAs



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

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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 2.5Gbit/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 atoms provide the active glass substrate, with optical gain in C- or L-band wavelengths.

In Teem Photnics' ion-exchange process, the active waveguide is formed as a localised increase in the substrate's refractive index. The process has three key advantages:

(i) low fixed manufacturing costs by a semi-automated process;
(ii) high production yields with limited operator intervention and testing; and
(iii) low start-up costs for on-demand production flexibility.

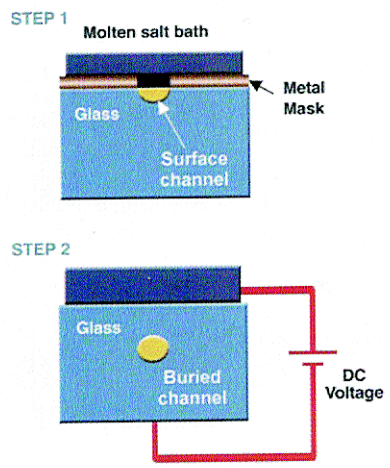
Another advantage is higher erbium doping (>10^{26} atoms/m^3) by using alumino-phosphate glass as an erbium medium. This provides higher optical gain/unit length, reducing gain medium length and allowing a component-sized optical amplifier a fraction the size of a conventional amplifier.

However, the more 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 (see Fig.1). A key advantage is the waveguide's ability to support confined transmission modes with low insertion loss (IL) and polarisation dependence gain (PDG) 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 under-estimated. 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).

Figure 1: Teem's proprietary planar platform technology is based on ion-exchange in glass and requires fewer wafer processing steps compared to silica on silicon PLC or SOI

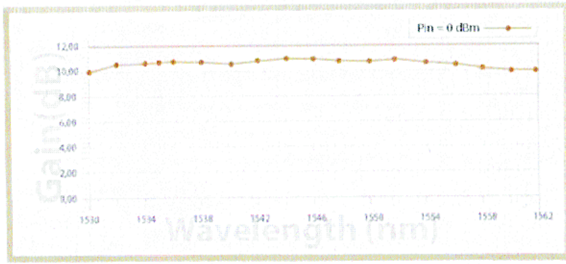


Metro EDWA

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.

Figure 2: Gainversus Wavelength of an EDWA, 10 dBm output power version at 0 dBm input power



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 board-mountable optical amplifier.

Also, we have designed a multi-port EDWA for high optical performance over several compact waveguide structures. The fully integrated 4EDWA Array four-port optical amplifier array — an industry first — offers 10dBm output per port with similar advantages to the single port, such as Mini-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 next-generation components/sub-assemblies.

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

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