

# RARE EARTH DOPED PHOSPHATE FIBRE AMPLIFIER AT 1.5 $\mu\text{m}$ for LIDAR

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The research work reports on the design and fabrication of a compact optical fibre amplifier operating at 1.5  $\mu\text{m}$ . A novel Yb/Er co-doped phosphate glass was developed and the optical fibre preform fabricated by rod-in-tube technique.

**Keywords:** optical fibre amplifier, LIDAR.

## 1. Introduction

High-power eye-safe laser detection and ranging (LIDAR) sources are used for remote sensing for aerospace and automotive applications [1,2]. They are usually made in master oscillator power amplifier (MOPA) configuration.

Traditional solutions are bulky, heavy and expensive, which does not make them suitable for installation on small/medium unmanned aerial vehicles (UAVs).

Phosphate glass optical fibres allow reducing the length of the power amplifier, thanks to their ability to incorporate high amounts of rare earth ions: this results in high optical gain per unit length [3, 4].

We report on the design, fabrication and characterization of a custom Yb/Er doped phosphate optical fibre, followed by the demonstration of optical gain using a pulsed seed laser operating at 1.5  $\mu\text{m}$ .

## 2. Experimental

The phosphate core and cladding glasses selected for this work were fabricated by melting a powder batch of high purity (99+%) chemicals inside an alumina crucible at a temperature of 1400 °C for 1 h. A multi-mode optical fibre was fabricated by preform drawing, with the preform obtained by the rod-in-tube technique.

The so fabricated fibre was used for optical gain measurements using a pulsed seed laser with a centre wavelength of 1538 nm. The laser specifications are: 20 mW average power, 0.7 ns pulse duration, 40 kHz of repetition rate which are equivalent to a ~670 W peak power. The seed was connected with a multi-mode and broadband pump laser (centre wavelength of 910 nm) by a pump combiner. The output of the pump combiner (9/125  $\mu\text{m}$ ) was butt coupled to the Er:Yb phosphate glass fibre with a 3-axis precision stage. A counter propagating second pump laser (976 nm with a core of 105  $\mu\text{m}$ ) was collimated with an aspheric lens of 20 mm focal length. Then, the collimated beam propagated through a dichroic mirror, focused onto the fibre cladding and the amplified seed was reflected by the dichroic mirror and through an optical filter into the power meter.

## 3. Results

The optical fibre was successfully drawn and featured: core and cladding diameters of 50 and 125  $\mu\text{m}$ , respectively; numerical aperture of 0.11; optical loss of 3.6 dB/m at 1300 nm.

The maximum peak power was measured to be ~1.6 kW, which is equivalent to an optical gain of 3.8 dB. This result was achieved with a 4 cm-long fibre sample (Fig. 1).

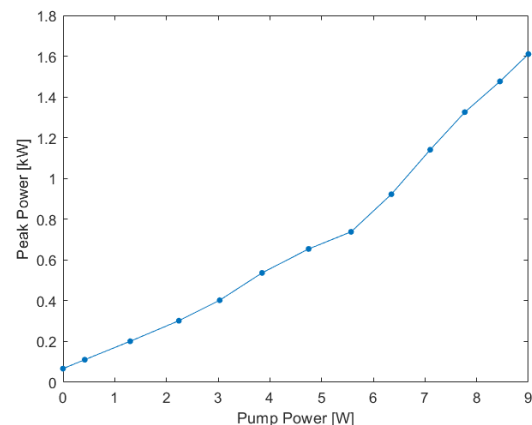


Fig. 1 Laser output peak power as a function of the pump laser diode total power.

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