[NS-06]

Nanocluster Si sensitization of Er-doped silica for optical gain at 1.54 μm using top-pumping 470 nm LED

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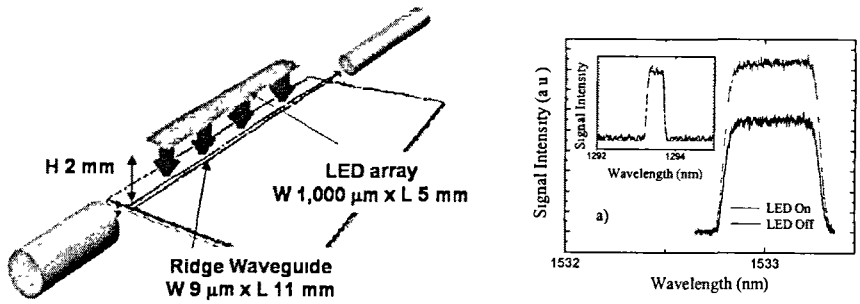
Amplification is fundamental to all communication networks. In particular, optical amplifiers, with their advantages of low noise, transparency, and built-in capability of dense wavelength division multiplexing have been critical in enabling all-optical telecommunication networks. Currently, all optical amplifiers, whether fiber- or waveguide-based, rely on expensive lasers as the pump source. Such a restriction must be removed if the cost and size of optical amplifiers is to be reduced, yet are required by the basic physical mechanism of optical amplification.

In this paper, we demonstrate that by using nanocluster-Si sensitization of Er-doped silica, optical gain may be obtained using a low-cost, 470 nm GaN light-emitting diode array instead. nc-Si act as the classical sensitizers, absorbing the pump beam and transferring the energy to Er^{3+} ions. However, since the absorption band of nc-Si is continuous, it allows substituting a low-cost, broadband light source such as an LED for an expensive laser. Furthermore, because of the large absorption cross section of nc-Si, sufficient pumping can be achieved in a top-pumping configuration without waveguides and coupler/de-couplers for the pump beam, resulting in significant reduction in the size and complexity of the final device. Such nc-Si sensitization opens the possibility of realizing compact, all-Si light sources that are critical for realizing Si-based photonics.



Schematic description of the amplifier setup and signal enhancement by LED pumping