# Integrated Al2O3:Er3+ microring and distributed feedback lasers on silicon

Authors : E.H. Bernhardi, K. Wörhoff, J.D.B. Bradley, R.M. de Ridder, and M. Pollnau
Integrated Optical Microsystems Group, MESA+ Institute for Nanotechnology, University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands

**Resume :** Integrated rare-earth-ion-doped dielectric lasers have found numerous applications in the medical, scientific, military and industrial fields, thanks to their high stability, low noise, narrow linewidth emission and broad wavelength tunability. Its favorable optical properties and compatibility with existing silicon waveguide technology make rare-earth-ion-doped aluminum oxide (Al2O3) a very promising gain medium to realize such integrated lasers.
Al2O3:Er3+ waveguide lasers are of interest due to their emission near 1.55 μm in the telecommunication C-band. The fabrication of low-loss Al2O3:Er3+ waveguides and internal optical gain over an 80-nm wavelength range with a peak gain of 2.0 dB/cm enabled the realization of various integrated Al2O3:Er3+ lasers on standard thermally oxidized silicon substrates. We report on the fabrication and performance of optically pumped channel waveguide ring and distributed feedback (DFB) lasers in Al2O3:Er3+. The low threshold ring-cavity lasers provide laser wavelength selection in the range 1530–1557 nm when varying the length of the output coupler from the ring. The DFB lasers exhibit output powers of more than 3 mW with slope efficiencies as high as 6.2% in single-frequency operation at 1545.2 nm with linewidths below 15 kHz. These performance data illustrate the significance of Al2O3:Er3+ as a laser gain medium in dense wavelength division multiplexing in telecommunication networks.