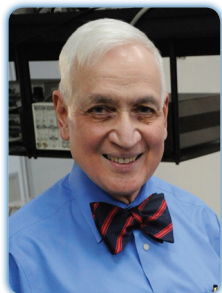


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MWIR and LWIR quantum cascade lasers

Mid wave infrared (MWIR) and long wave infrared (LWIR) spectral regions, from 3.0 μm to $>12 \mu\text{m}$, are important for a broad range of defence, homeland security and civilian applications, which include protection of aircraft from shoulder-fired missiles (MANPADS), target designators/illuminators, IFF beacons, *in-situ* and standoff detection of explosives, IEDs, chemical warfare agents and toxic industrial chemicals, infrared spectroscopy in healthcare and bio-pharma industries. QCLs, invented in 1970's and first demonstrated in 1994, are the only broadly tunable lasers that operate CW at room temperature in these spectral regions and therefore are rapidly gaining acceptance from the user community. Two groups (Northwestern and Pranalytica) have made significant improvements in the QCL performance, including CW power output at room temperature and wall plug efficiency. CW/RT power output approaching 5 W together with wall plug efficiency approaching 20% at a wavelength of $\sim 4.6 \mu\text{m}$ have been demonstrated. The size, weight and power (SWaP) advantages of QCLs are key to the rapidity with which QCLs are replacing other sources of MWIR/LWIR laser radiation, such as optical parametric oscillators and optically pumped semiconductor lasers, in these spectral regions. Pranalytica's invention of new QCL structure design has permitted extension of high powers to wavelengths shorter and longer than $4.6 \mu\text{m}$. With watt level powers available, QCLs have an opportunity to displace the traditional CO₂ lasers in many low power applications in $10 \mu\text{m}$ region. The author will describe recent advances in QCL science, technology and performance and applications of QCLs in many of the aforementioned areas.

Biography

Chandra Kumar Naranbhai Patel is the President and CEO of Pranalytica, a company that develops and manufactures leading edge QCLs and high sensitivity sensors for the detection of CWAs, explosives and industrial and environmental pollutants. He is concurrently a Professor of Physics and Astronomy at UCLA. He is the inventor of the carbon dioxide laser. He pioneered the use of CO₂ and other lasers to measure trace gases. He was at AT&T Bell Laboratories for thirty-two years and was Executive Director of the Materials Research Division. From 1993 to 1999, he was the Vice Chancellor for Research at UCLA. He is a member of the NAS and NAE. He was awarded the National Medal of Science by the President of the United States in 1996. He was inducted into the U.S. National Inventors Hall of Fame in 2012. He has served on the Board of Directors of Newport Corporation since 1986.

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