# Will high-density PICs be the next big thing?

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Gary Evans in SMU's Photonics Lab.

(PhysOrg.com) -- Lasers have the potential to improve and revolutionize human lives in many ways, from consumer electronics and communications to medical equipment and homeland security. Helping unlock the barriers to these advancements is the research of SMU Electrical Engineering Professor Gary Evans.

Evans has been recognized by his peers for his contributions to the development, design and fabrication of semiconductor lasers, microscopic manufactured devices that can amplify subatomic light particles called photons.

This technology, in turn, can lead to applications that transmit data, energy, pictures or sound.

The field of photonics already has many claims to fame: Laser pulses deliver information through glass fibers to create the high-speed Internet ; certain wavelengths of laser light are used in cancer therapy; lasers read CDs and DVDs; and at industrial plants, lasers cut materials with precision.

But future development of high-power applications requires research advancements of the kind Evans is tackling in his laboratory: He is looking for a way to fit billions of lasers and other optical components atop a microscopic chip.

The challenge is similar to the one faced in the late 1950s by the engineers who developed the electronic integrated circuit. The revolutionary high-density electronic integrated circuit paved the way for powerful hand-held calculators, laptop computers and myriad microelectronic devices and technology that have transformed the world.

Evans and other researchers believe photonic integrated circuits (PICs) may have that same vast potential, but there are technical problems to resolve. One key to manufacturing high-density PICs, which can hold billions of optical devices, is an "isolator." An isolator would allow photons to flow unrestricted in the forward direction, but would prevent any reflected light from traveling backward. Without an isolator, unavoidable reflections would cause instabilities and chaos in the PIC.

"An isolator allows integration of large numbers of lasers and other optical components to produce stable, robust photonic circuits," Evans says. Since 1994 he and Jacob Hammer, a retired colleague from RCA Labs, have been working along with graduate students to develop an isolator.

"We have a good understanding of the theory and we realize what problems need to be solved to make an integrated isolator in a

semiconductor," Evans says. "But more theory needs to be done to understand the materials that need to be developed. The materials just don't exist yet."

He is seeking federal funding to continue collaborations with Hammer, the University of California, Santa Barbara and the U.S. Naval Research Laboratory to develop those materials.

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