# New plasma transistor could create sharper displays

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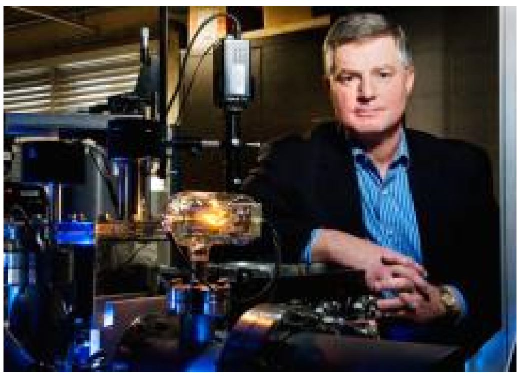

Gary Eden, a professor of electrical and computer engineering at Illinois, and colleagues have created a plasma transistor that could be used to make lighter, less expensive and higher resolution flat-panel displays. The researchers have applied for a patent. Photo by L. Brian Stauffer

(PhysOrg.com) -- By integrating a solid-state electron emitter and a microcavity plasma device, researchers at the University of Illinois have created a plasma transistor that could be used to make lighter, less expensive and higher resolution flat-panel displays.

"The new device is capable of controlling both the plasma conduction current and the light emission with an emitter voltage of 5 volts or less," said Gary Eden, a professor of electrical and computer engineering, and director of the Laboratory for Optical Physics and Engineering at the U. of I.

At the heart of the plasma transistor is a microcavity plasma, an electronic-photonic device in which an electrically charged gas (a plasma) is contained within a microscopic cavity. Power is supplied by two electrodes at voltages of up to 200 volts.

Eden and graduate student Kuo-Feng (Kevin) Chen fabricated the plasma transistor from copper-clad laminate into which a microcavity 500 microns in diameter was produced by standard photolithographic techniques. The solid-state electron emitter was made from a silicon wafer, topped with a thin layer of silicon dioxide.

The microcavity is approximately the diameter of a human hair, and is filled with a small amount of gas. When excited by electrons, atoms in the plasma radiate light. The color of light depends on what gas is placed in the microcavity. Neon emits red light, for example, and argon emits blue light.

Around the plasma is a thin boundary layer called the sheath. Within the sheath, electrical current is carried not by negatively charged electrons, but instead by positively charged ions. Much heavier than electrons and therefore harder to accelerate, the ions require a large electric field generated by a large voltage drop across the sheath.

The intense electric field within the plasma sheath also promotes electron transport, said Eden, who also is a researcher at the university's Coordinated Science Laboratory and at the Micro and Nanotechnology Laboratory. "By injecting electrons from the emitter into the sheath, we can significantly increase the flow of electrons through the plasma, which increases the plasma's conductivity and light emission."

While the microcavity plasma still requires up to 200 volts to emit light and conduct current, the current and light emission can be controlled by an electron emitter operating at 5 volts or less, Eden said. The current that is sent through the sheath to the bulk plasma determines how much current is carried by the two electrodes driving the microplasma.

In previous work, Eden's team created flat-panel plasma lamps out of two sheets of aluminum foil separated by a thin dielectric layer of clear aluminum oxide. More than 250,000 lamps can be packed into a single panel. And, because microcavity plasmas operate at atmospheric pressure, thick pieces of glass are not needed to seal them. The lightweight plasma panels are less than 1 millimeter thick.

"Being able to control each microcavity plasma independently could turn our plasma panel into a less expensive and higher resolution plasma display," Eden said. "The plasma transistor also could be used in applications where you want to use a small voltage to control a great deal of power."

Eden and Chen described the plasma transistor in the journal *Applied Physics Letters*. The researchers have applied for a patent.

Source: University of Illinois at Urbana-Champaign

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