PORTLAND, Ore. — A solid-state, white-light source that is said to be brighter on a per-watt basis than incandescent bulbs has been described by a University of Michigan researcher.

White organic light-emitting diodes (OLEDs) are already producing more light per watt than incandescent bulbs, according to engineering professor Stephen Forrest, but it is trapped inside the device. By fabricating a tandem system of grids and micro lenses on a white OLED, the device can achieve a brightness of over 70 lumens per watt, compared with 15 lumens for incandescent bulbs--almost as much as fluorescent tube lights (90 lumens).

"We have achieved 78 lumens using our grid and lens structures--almost as much as fluorescents," said Forrest. "And when you consider that a lot of the fluorescent tubes light is lost, since it comes out it all directions around the tube, our white OLEDs will be perceived in many applications as brighter than fluorescents."

Forrest claims his breakthrough will enable white OLEDs to eventually replace both incandescent bulbs and fluorescent tubes with light-panels that can be shaped differently for specific applications.

The market for white OLED light panels could be enormous since lighting accounts for 22 percent of all U.S. electricity consumption. The Michigan Memorial Phoenix Energy Institute at the University of Michigan, which cooperated in the development of Forrest's invention, is focusing on "green" alternatives to coal-generated electricity.

White OLEDs generate light using electron-hole recombination in layers of organic semiconductors--carbon-based dyes that are already widely available. By fabricating the organic semiconductors on inexpensive plastic or metal-foil substrates, white OLEDs promise to lower the manufacturing costs of lighting by using low-temperature, roll-to-roll manufacturing techniques instead of expensive silicon substrates.

Unfortunately, up to 60 percent of the light generated by white OLEDs is trapped inside the semiconducting layers--reflected back from the glass lid of the device. Instead, Forrest uses a layer of grids etched in silicon dioxide that refracts the trapped light through the glass lid into a layer of dome-shaped micro-lenses that direct the trapped light out of the device.

Next, Forrest plans to work with Universal Display Corp, (Ewing, N.J.) to create even brighter white OLEDs and to lower the manufacturing costs for grids and lenses.

"Universal Display uses a more efficient process than we had--they are already getting 120 lumens from their white OLEDs," said Forrest. "If they choose to add our grids and lenses, then their white OLEDs will much much brighter than fluorescents."
Funding for Forrest's work was provided by Universal Display and the U.S. Energy Department.