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Controlled Growth of ZnO Microcrystals Achieved

Although ZnO-based microcrystals hold promise in a number of applications, current fabrication techniques are hampered by problems that have limited their effectiveness and their appeal.

Fabrication, for instance, has been held back by a shortage of high-quality *p*-doped ZnO. As a result, many researchers have been working with *n*-doped ZnO. Most of the ZnO-based devices suffer from a defect in the emission at around 585 nm.

Researchers Heiko O. Jacobs and Jesse J. Cole and colleagues from the University of Minnesota in Minneapolis report that they have devised a technique to produce highly uniform arrays of hexagonal-shaped single ZnO crystals.

The manufacturing technique could be used to create microcrystals for use in devices including micro-LEDs, microphotovoltaic cells, laser cavities, sensors and piezoelectric actuators.

The investigators produced single ZnO disk-type structures on top of *p*-type GaN. The technique relied upon a plasma process and photoresist patterns to reveal sites that nucleate growth. This was followed by epitaxial overgrowth that produced patterned areas of ZnO over 2-in. wafers.

The process was used to produce ZnO/GaN micro-LEDs and UV photovoltaic cells. The LEDs exhibited strong near-band-edge electroluminescent emission and the emission defect typically present in the red and yellow was absent, suggesting that the ZnO microcrystals were of high quality.

The fabrication process also allowed for precise control over both the placement and size of the microcrystals. In terms of dimensions, the structures had <1 percent standard deviation in size and 0.7 percent standard deviation in location. This level of control over such parameters could lead to further studies of light coupling and lasing as well as the transfer of single-crystal domains from one substrate to another, enabling studies of flexible transparent electronics. □

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