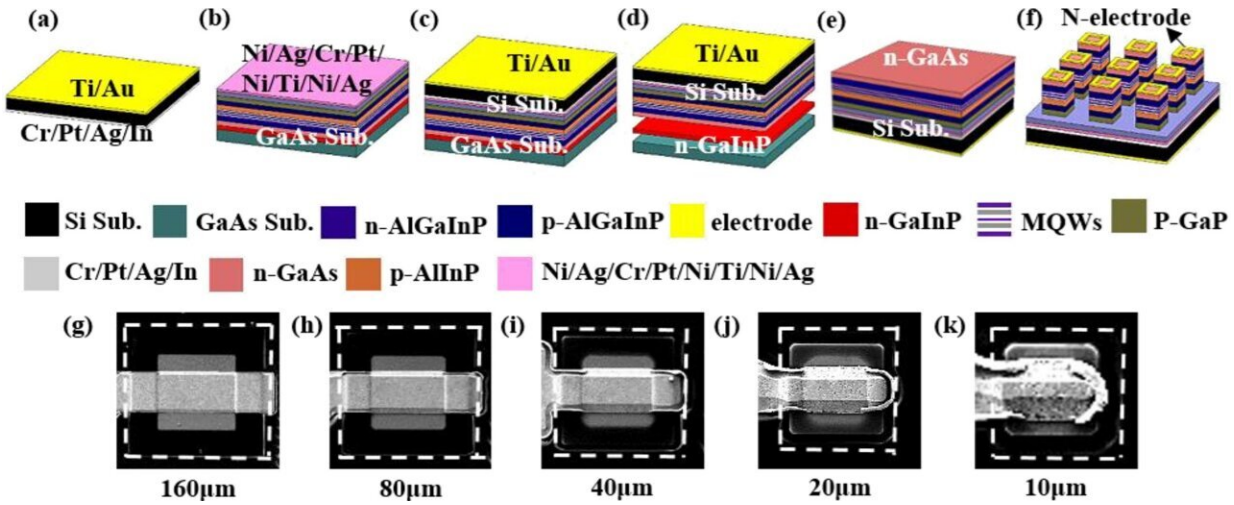
Size effect of AlGaInP red micro-LEDs on silicon substrate

May 26 2022, by Zhang Nannan



Process flow of red vertical micro-LEDs on Si substrate: (a) deposition of different metal layers on Si wafer, (b) deposition of different metal layers on the epitaxial wafer, (c) bonding, (d) separation of GaAs substrate from the LED structure, (e) exposing of the n-GaAs layer, (f) inductively coupled plasma etching and deposition of metal electrodes. Scanning electron microscope images of different chip sizes are shown: (g) 160 μm, (h) 80 μm, (i) 40 μm, (j) 20 μm, and (k) 10 μm. Magnification varies by image. The white dotted line is the LED light-emitting area. Sub. = substrate. MQW = multiquantum well. Credit: *Results in Physics* (2022). DOI: 10.1016/j.rinp.2022.105449

Micro-LEDs have been used in many fields due to their superior performance, such as micro-displays, visible light communication,

optical biochips, wearable devices, and biosensors. Obtaining high resolution and high pixel density is one of the key technical challenges of working with micro-LED array displays, as it requires smaller and smaller chip sizes and pixel pitches.

In a study published in *Results in Physics*, a research group led by Prof. Liang Jingqiu from the Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP) of the Chinese Academy of Sciences investigated the size effect of aluminum gallium indium phosphide (AlGaInP) red Micro-LEDs on silicon substrate.

The researchers adopted a low-damage etching formula and silicon substrates with better heat dissipation to avoid the light absorption properties of GaAs substrates.

Experimental results show that smaller micro-LEDs have smaller leakage current and larger series resistance and can withstand higher current density without the current crowding effect.

Due to the larger perimeter-to-area ratio of small-sized micro-LEDs, non-radiative recombination increases, which leads to a lower external quantum efficiency. But smaller micro-LEDs can alleviate the problem of the high-current efficiency droop.

In addition, because of a better heat dissipation under a high injection current, smaller micro-LEDs (