

Abstract

METHODS OF HYPERDOPING SEMICONDUCTOR MATERIALS
AND

5 **HYPERDOPED SEMICONDUCTOR MATERIALS AND DEVICES**

Methods are disclosed for producing highly doped semiconductor materials. Using the invention, one can achieve doping densities that exceed traditional, established carrier saturation limits without deleterious side effects.

10 Additionally, highly doped semiconductor materials are disclosed, as well as improved electronic and optoelectronic devices/components using said materials. The innovative materials and processes enabled by the invention yield significant performance improvements and/or cost reductions for a wide variety of semiconductor-based microelectronic and optoelectronic devices/systems.

15 Materials are grown in an anion-rich environment, which, in the preferred embodiment, are produced by moderate substrate temperatures during growth in an oxygen-poor environment. The materials exhibit fewer non-radiative recombination centers at higher doping concentrations than prior art materials, and the highly doped state of matter can exhibit a minority carrier lifetime

20 dominated by radiative recombination at higher doping levels and higher majority carrier concentrations than achieved in prior art materials. Important applications enabled by these novel materials include high performance electronic or optoelectronic devices, which can be smaller and faster, yet still capture or emit light efficiently, and high performance electronics, such as transistors, which can

25 be smaller and faster, yet cooler.

Figure 2B