

## Atmospheric Pressure Electrolytic Growth of GaN in a Molten Salt

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The development of large area native GaN substrates has been frustrated by both the thermodynamics and kinetics of the reactions involving nitrogen precursors, which typically require high pressures and temperatures. Such pressures will ultimately limit the scalability of the process, and throughputs are slow. We have recently demonstrated growth of 0.2 to 0.9-mm sized GaN particles in two hours using an electrochemical approach in a molten chloride salt at atmospheric pressure and 450°C (see Figure 1). The precursors used were gallium metal and Li<sub>3</sub>N. Contact was made to the gallium pool via a platinum wire; the counter electrode was made from nickel. Electron dispersive spectroscopy was used to verify the presence of nitrogen in the crystals, and powder x-ray diffraction confirmed the formation of wurtzite GaN. The technique is scalable, controllable, reasonably inexpensive, relatively safe, and amenable to *in situ* monitoring, thereby setting the stage for the development of a manufacturable process. The process will be described and the effect of critical processing parameters, such as temperature, voltage, and current density on the microstructure and optical properties of the crystals. The possibility of using N<sub>2</sub> gas as a precursor via electrolytic reduction of nitrogen to nitride (N<sup>3-</sup>) according to Goto and Ito<sup>1</sup> will be discussed. Adaptations of the approach geared toward achieving large-area boules of nitride materials, as well as the potential for application to other materials, will be discussed.



**Figure 1** Scanning electron microscopy image of one of the crystals formed during molten salt electrolytic growth of GaN.

<sup>1</sup> T. Goto and Y. Ito, *Electrochimica Acta*, Vol. 43, Nos 21-22, pp. 3379-3384, 1998