New gallium nitride film method beats the heat

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A team of Los Alamos National Laboratory scientists have developed a method for growing crystalline gallium nitride films at lower temperatures than industry standards. By eliminating the higher temperatures and harsh, reactive environments that currently limit the types of materials used as substrates, the discovery could greatly increase the use of crystalline gallium nitride films in optical-electronic devices, like blue LEDs and laser diodes, high-density optical data storage devices, flat panel displays and solid state lighting.

In research published recently in *Applied Physics Letters*, the team describes their use of energetic neutral atom-beam lithography/epitaxy to grow crystalline and polycrystalline gallium nitride (GaN) films on bare c-axis-oriented sapphire at temperatures between 100 and 500 degrees Celsius using low kinetic energy nitrogen atoms and a simultaneous flux of gallium metal.

Energetic neutral atom-beam lithography, or ENABLE, is a Los Alamos system that produces a beam of neutral atoms with low kinetic energies that can be used for various kinds of specialized surface chemistry at near room temperatures, often producing results that are unattainable using other techniques. Epitaxy is the process of growing one crystal layer of a material of another crystalline substance.

According to Mark Hoffbauer, the principal investigator for the GaN ENABLE project, "the beauty of using ENABLE for growing crystalline gallium nitride films is that normally the process requires substrate temperatures of 900 to 1,100 degrees Celsius and extremely harsh, reactive environments. Those conditions eliminate a lot of useful materials as substrates because they would melt or be degraded at the higher temperatures. Our lower temperature technique has the potential to allow gallium nitride films to be grown on many more types of inexpensive substrate materials, including glass and certain polymers."

Another researcher on the team, Alex Mueller adds, "The low temperatures employed by ENABLE allow for the incorporation of electronic and magnetic dopants into the films while simultaneously avoiding phase segregation and clustering problems that are limiting the widespread use of these materials in other applications. The fact that there are no impurities inherent in the ENABLE process make defect and impurity free films possible, thereby simplifying device fabrication."

Source: Los Alamos National Laboratory

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