Researchers 'heal' plasma-damaged semiconductor with treatment of hydrogen radicals

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Gallium nitride (GaN) is a highly promising material for a wide range of optical and high-power electronic devices, which can be fabricated by dry etching with plasmas. However, the plasma-induced defects and surface residues that remain after such processes tend to degrade the optical and electrical properties of the devices. A team of Japanese researchers has developed and tested a new way to "heal" such defects.

The team exposed plasma-damaged GaN to hydrogen (H) radicals at room temperature. After testing various doses of H radicals, the researchers evaluated the optical properties of the GaN. The intensity of light emitted when electrons near the edge of the valence shell in GaN absorbed and then re-emitted photons drastically decreased after chlorine plasma-beam etching. After treatment with the higher-level doses of H radicals, however, the photoluminescence was restored to almost the level of un-etched GaN.

The H radicals likely terminated the dangling bonds of Ga on the GaN surface, as well as desorbed the surface residues, which both led to the recovered optical performance. A key characteristic of the new healing process, described in a paper accepted to the American Institute of Physics' journal *AIP Advances,* is that it is performed in situ immediately after the etching process. This is important because unwanted surface oxidation can easily occur on plasma-damaged GaN that is exposed to air.

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