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High Response Deep UV Photodetectors for Use in the Solar Blind Region

UCF researchers have developed $\text{Mg}_x\text{Zn}_{1-x}\text{O}$ film with a ZnO homo-nucleation layer to be included in optical photodetectors and emitters operating in the UV spectral region.

Most of the UV light from the sun is absorbed by the atmospheric ozone layer. In the solar-blind region, the ozone layer in our atmosphere absorbs nearly 100% of solar radiation for wavelengths shorter than 290 nanometers. UV detectors that have high sensitivity to UV-C and far UV radiation compared to radiation with wavelengths longer than 280 nm can be called 'solar-blind.' Conventional hexagonal lattice structures in semiconductors have suffered from various problems including cracking due to strain and reduced internal quantum efficiency. In addition, difficulties often arise from the lack of a suitable lattice matched substrate, leading to higher dislocation densities. UV photodetectors and light emitters have drawn extensive attention, because of their wide field of use.

Applications

In aerospace and defense applications, UV photodetectors sense heat sources such as flames, jet engines, or missile plumes that emit light throughout the UV portion of the spectrum. By using these new semiconductor alloys in optoelectronic and microelectronic devices, the UV photodetectors can operate in the solar-blind region allowing for faster, more reliable detection of threats or consistent communications in space than compared to previous materials.

Advantages

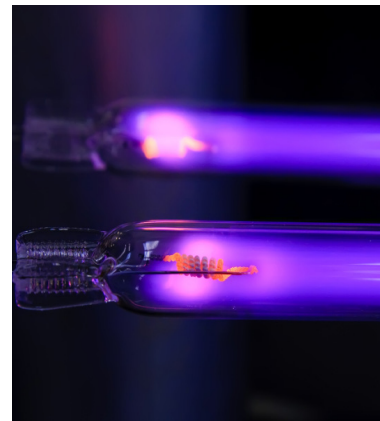
While cubic MgZnO thin films with an Mg composition higher than 62% exist, they are low quality, and the photodetectors with these films only show low responsivity. UCF researchers have created ZnO thin films with high crystalline quality, low defect, low dislocation densities, and sub-nanometer surface roughness by depositing on a low temperature ZnO nucleation layer. By including a low temperature ZnO nucleation layer on the substrate, the properties of the top wurtzite ZnO layer are enhanced improving responsivity of the photodetector.

Technical Details

UCF researchers have overcome the difficulty of growing single wurtzite phase MgZnO with a high Mg concentration by adding a low temperature ZnO nucleation layer on the substrate, such as that grown at 300-400 °C. By changing the MgO concentration, $\text{Mg}_x\text{Zn}_{1-x}\text{O}$ has a tunable 25 °C bandgap from 3.3eV for wurtzite ZnO to 7.8 eV for rock salt MgO . By tuning the Mg concentration and by controlling the Mg/Zn flux ratio during deposition, the process achieves a steep optical absorption edge of the wurtzite $\text{Mg}_x\text{Zn}_{1-x}\text{O}$ with a spectral cutoff wavelength ranging from 278 nm to 377 nm. High crystal quality and optical quality single crystal $\text{Mg}_x\text{Zn}_{1-x}\text{O}$ layers were grown epitaxially on c-plane sapphire substrates by plasma-assisted Molecular Beam Epitaxy (MBE). The photoconductors constructed with these films have demonstrated responsivity as high as ~102 A/W with a rejection ratio of two orders of magnitude in the solar-blind spectral range with a spectral cutoff of 278 nm.

UCF Inventors

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Benefits

- High crystalline quality
- Low defect
- Low dislocation densities
- Sub-nanometer surface roughness

Applications

- Covert space-to-space communications
- Missile threat detection
- Chemical or biological threat detection
- Environmental monitoring
- Germicidal cleansing

Tech Fields

Aerospace, Defense

Keywords

UV, photodetectors, semiconductor alloys, optoelectronic, microelectronic devices, solar-blind region, wurtzite, magnesium zinc oxide

If you or your company are interested in this opportunity, Contact:

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