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Nanostructured InGaN for biomedical application

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Epitaxial growth of GaN and InGaN heterostructures is very promising for biosensor applications due to their excellent chemical stability, biocompatibility with low toxicity to living cells, and high carrier mobility [1]. Compared to InN thin films, InGaN quantum dot (QD)-based biosensors demonstrate a twofold increase in sensitivity and a fivefold faster response. While significant progress has been made, optimization of InN QD deposition, InGaN growth, and sensor functionalization remains crucial for realizing wearable transdermal biosensors (WTBs). The InGaN nanostructured thin films were grown using Plasma-Assisted Molecular Beam Epitaxy (PA-MBE) on Si (111) substrates, enhancing the sensitivity of the biosensors. The growth mechanism and geometrical properties of the InGaN nanocolumns were investigated using scanning electron microscopy. Structural characterization and accurate surface morphology analysis were performed. We investigated the variation in nanocolumn shape, density, and diameter as a function of the In/Ga ratio, which was controlled by deposition parameters. We show that achieving high indium content (40–50%) is critical for maximizing surface state energy and enabling ohmic contact between p-type Si and n-type InGaN. Nanostructured InGaNs are promising as a platform for biosensors functionalized with disease-specific antibodies dissolved in hydrogels to recognize target proteins, with a redox reaction indicating their presence.
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1. M. Azadmand et al., Nanomaterials (Basel) 3,12 (2022) 3887.

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