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Influence of a buffer layer on the electrical properties of ZnO/Si heterojunction

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Abstract content
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As a wide band gap semiconductor, zinc oxide (ZnO) has attracted a great deal of attention because of the desire to fabricate, for example, efficient ultraviolet light-emitting diodes. ZnO is also of interest because it exhibits a large exciton binding energy of 60 meV, allowing exciton-governed light emission at room temperature. Up to now, light emission from ZnO homojunctions is difficult to achieve due to the lack of stable p-type doping. This difficulty has prompted researchers to focus on p-n heterojunctions with different substrates, among them silicon (Si), which is cheaper and readily available. The two main problems of using Si as the p-side of the junction are lattice mismatch and the nature of the band offsets. The problem of band offset arises from the type II staggered band alignment between ZnO and Si. This results in a large valence band offset and a small conduction band offset, causing electron-hole (e-h) recombination on the Si-side of this type of junction. It is believed that efficient electroluminescence from ZnO light emitting diodes will be achieved by inserting a barrier layer, which can simultaneously confine electrons in the ZnO region and allow the holes in the Si valence band to be injected into the ZnO side during forward bias, so that the recombination happens in the ZnO. Aluminium nitride (AlN), magnesium oxide (MgO) and nickel oxide (NiO) have been used to study the effect of a barrier layer on the electrical properties of the device . Their influence as well the effect of barrier layer thickness is discussed in detail.

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Prof JR Botha, Reinhardt.Botha@nmmu.ac.za, NMMU

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Primary author: Mr TANKIO DJIOKAP, Stive Roussel (Nelson Mandela Metropolitan University)

Co-authors: Mr MBULANGA, Crispin (NMMU); Prof. BOTHA, Johannes Reinhardt (NMMU); Dr URGESSA, Zelalem N. (NMMU)

Presenter: Mr TANKIO DJIOKAP, Stive Roussel (Nelson Mandela Metropolitan University)

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