Heterogeneous material integration through guided lateral growth

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Description:

A crystalline semiconductor device fabrication method that is i) capable of integrating generic substrates ii) enables growth of single crystalline semiconductor without a seed (from fiber-textured thin film).

By inducing crystallographic alignment along one axis on essentially arbitrary substrates, this method utilizes lateral guided, selective-area, and channeled growth to drastically reduce the in-plane (orthogonal) misalignment, thus obtaining single-crystalline device layers on essentially any substrates.

While this principle can be applied to many possible sets of combinations (substrates, fiber-textured layer, device layer), one particularly intriguing and promising choice would be the preparation of device quality Gallium Nitride through lateral guided growth on sputtered Aluminum Nitride or Titanium Nitride on oxide on Si that will integrate two mainstream technologies: the Silicon-based microelectronics, and the Gallium Nitride-based opto- and power- electronics.
Field of Application: High-performance gallium nitride light emitting diodes and transistors

Advantages: ‘Thermal expansion mismatch’ is a billion dollar problem that has precluded high-power GaN from integration with Si and CMOS manufacturing strategies. This technology overcomes thermal expansion mismatch. It enables growth of GaN islands on silicon. Lattice mismatch is also no longer an issue, since the bond to substrate is not covalent. The implementation of this technology will drive down the cost of GaN devices. In addition, fabrication will no longer be limited to 8” wafers (current largest sapphire wafer).

Stage of Development: 10x4micron demonstrated; 20x50 device expected December 2012.

Publications:

Patent application and research findings available under confidentiality

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