J Phys Chem Biophys 2015, 5:3
http://dx.doi.org/10.4172/2161-0398.S1.011

Germanium for photonic applications

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Polycrystalline and crystalline germanium have been demonstrated to be excellent materials for the fabrication of integrated microsystems in complementary metal oxide semiconductor (CMOS) micro-electromechanical systems (MEMS) and photonics. Crystalline Germanium or Silicon Germanium on silicon or insulator is also a desirable and preferred system for applications in near infrared and mid infrared photonic devices. For near infrared, Silicon Germanium is crucial for the fabrication of detectors QCSE modulators and detectors and Franz Keldysh modulators. When extended to mid infrared wavelengths, Germanium becomes one of the wave guiding media of choice, with optical transmission all the way up to 10 microns. In order to fabricate optical components and enable the confinement of light in the horizontal and vertical direction, the deposition of high quality crystalline Germanium on insulator is of utmost importance. In this paper we demonstrate a novel way to obtain crystalline Germanium and Silicon Germanium on insulator for near infrared devices and we introduce a new platform for the fabrication of mid infrared integrated circuits.

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Structural and optical properties of si-doped al0.08In0.08Ga0.84N thin films grown on different substrates for optoelectronic devices

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The objective of the current study is to characterize the optoelectronic properties of quaternary n-Al0.08In0.08Ga0.84N thin films grown via molecular beam epitaxy (MBE) on sapphire (Al2O3) and silicon (Si) substrates for different optoelectronic applications. Due to mismatch problems between the epilayer and substrates, the AlN buffer layer was inserted at low temperature to reduce the lattice mismatch to approximately 4% for the samples, to produce high-quality epitaxy films. Defect-free films with high structural, optical and electrical qualities were obtained. Their small full width at half maximum, low compressive strain, relatively large grain size and low dislocation density which produced smooth surfaces without any separation phases or cracks were characterized using X-ray diffraction analysis. Scanning electron microscopy, energy-dispersive X-ray microscopy and atomic force microscopy images confirmed these characterizations. Furthermore, high optical quality, as well as high absorption and absorption coefficients were observed using photoluminescence and UV-VIS spectroscopy; however, a red shift was observed in the PL peak of the near band edge of 3.158 eV of the sample on Si substrate compared with 3.37 eV for the sample on sapphire substrate which is attributed to the compressive strain and occurrence of the quantum confined Stark effect. Two expected phonon modes of the film on the sapphire substrate were observed at 546 cm-1 and at approximately 799 cm-1.

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