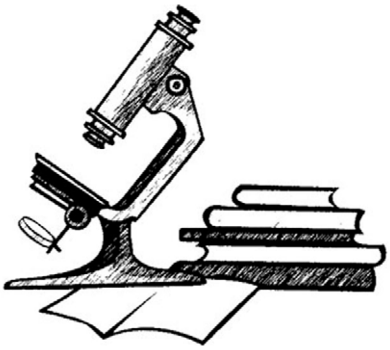

Research, reviews & patents

Temperature-insensitive VCSEL

VCSELs in operation must typically perform at a temperature of about 80°C, due to variation in the ambient temperature and heating in the device package. Thus, VCSELs commonly require some form of temperature compensation. Conventional are broadly optical feedback and active cooling.

In US patent no 6,879,612 granted in April 2005, John Wasserbauer has produced a temperature-insensitive vertical cavity laser, which includes an active region that has many quantum wells (InGaAs/AlGaAs) formed between the first and second mirrors.

The gain of each of the QW or groups of QWs operate quasi-independently at different temperatures so that stimulated emission is dominated by a different QW or group of QWs at different temperatures. The patent is assigned to Optical Communication Products Inc.

Relaxed SiGe substrate with low defect density

Chun Chich Lin and nine colleagues at TSMC ARE were awarded US patent no 6,878,610 in April, having worked on a method of forming a strained silicon layer on a relaxed, low defect density semiconductor alloy layer such as SiGe.

In the first part of this invention, the relaxed, low density SiGe layer is epitaxially grown on an silicon layer which, in turn, is located on an underlying SiGe layer.

During the epitaxial growth of the overlying SiGe, layer defects are formed in the underlying silicon layer, resulting in the desired relaxation and decreased defect density for the SiGe layer.

An anneal procedure performed during growth of the relaxed SiGe layer, results in additional relaxation and decreased defect density, while an anneal procedure performed to the underlying silicon layer prior to epitaxial growth of the relaxed SiGe layer, again allows optimised relaxation and defect density to be realised for the SiGe layer.

The ability to obtain a strained silicon layer on a relaxed, low defect density SiGe layer, allows devices with enhanced carrier mobility to be formed in the surface of the strained silicon layer, with decreased risk of leakage due to the presence of the underlying, relaxed low defect density SiGe layer.

Single crystal & substrate

A team of five with Maysaya Ohnishiat at Hitachi Cable have worked to develop a method for growing a single crystal of a compound semiconductor and its cut substrate, and have been awarded US patent no 6,878,202.The invention is a method for growing a compound semiconductor single crystal, which has an extremely uniform carrier concentration distribution in a surface perpendicular to the crystal growth axis direction, and suffers from few losses when substrates are cut out. It also produces a substrate, with a uniform radial distribution of carrier concentration.

Atomic-scale surfaces

An article in the most recent volume of *Applied Surface Science* description. Atomic-scale theoretical investigations of clean and covered low-index surfaces of compound semiconductors. Particular emphasis is placed on the role of the electron counting rule (ECR) in governing plausible surface reconstructions.The article discusses trends for the characteristic tilt of the topmost atomic layer and the highest localised phonon mode on nonpolar III–V(1 1 0) surfaces, including III-nitride compounds. Reconstructions and electronic properties of polar surfaces are explained as dimer formation on (0 0 1), and trimer and/or chain formation on (1 1 1) faces. Some surface reconstructions stabilise as a result of a balance between the ECR and minimization of adsorbate-induced local distortion. This is demonstrated for the long-range ordered reconstruction on the Sb:GaAs (1 1 1) B surface. G.P. Srivastava, School of Physics, University of Exeter, UK *Applied Surface Science* 244,(1-4) 129-136 (15 May 2005)

Electron-conducting QDs

Optical and electrical properties of solids that are composed of semiconductor nanocrystals are reviewd by Daniel Vanmaekelbergh and Peter Liljeroth at the Debye Institute, University of Utrecht, The Netherlands. Crystals, dimensioned in the nanometre range, of II-VI, IV-VI and III-V compound, can be prepared by wet-chemical methods with a remarkable size, shape, and surface chemistry control. In the uncharged ground state, such nanocrystals are insulators. Electrons can be added, one by one, to the conduction orbitals, forming artificial atoms that are strongly confined in the nanocrystal.

Semiconductor nanocrystals form the building blocks for larger architectures, which self-assemble due to van der Waals interactions. The electronic structure of the quantum dot solids prepared in such a way is determined by the orbital set of the nanocrystal building blocks and the electronic coupling between them. The opto-electronic properties are dramatically altered by electron injection into the orbitals. The optical and electrical properties of QD solids in which the electron occupation of the orbitals is controlled by the electrochemical potential is discussed. Chemical Society Reviews 34 (4) 299-312 (April 2005)
E-mail daniel@phys.uu.nl.