physica status solidi rrl

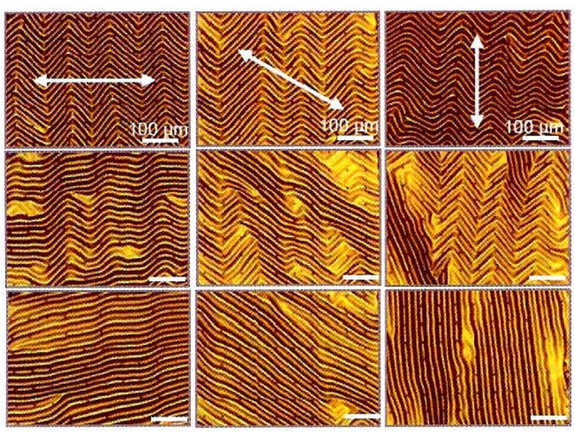
Switchable two-colour light source on a silicon chip

Silicon is the most important material for electronic chips and processors. Yet it has a big drawback: being an indirect semiconductor, it hardly emits any light. Physicists at the Forschungszentrum Dresden-Rossendorf (FZD), Germany, now managed to make silicon shine red and blue in an alternating fashion.
The FZD has worked successfully for several years on the realization of silicon based light emitters. Initially the physicists made a blue-violet emitter, which was then the basis of a Si-based optocoupler. In 2004 they demonstrated ultraviolet, and then green light emitters [7]. Now the physicists can switch the characteristics of the emitted light between two colours – red and blue – at will, depending only on the electrical current flowing through the device [8]. The compatibility of these emitters with standard Si microelectronic technology is crucial, since the two-colour nano-switch could easily be integrated into common silicon microchips.
For the fabrication of the test devices the group around Wolfgang Skorupa deposits a 100 nm thin insulating silicon dioxide layer on the surface of the silicon wafer. Then the rare-earth element europium is ion-beam implanted. The peculiarity of Eu lies in the fact that it forms two different types of impurities carrying a different charge (oxidation state). These are the origin of the red and blue luminescence. Depending on the strength of the electrical current one or the other impurity type is excited to emit photons. Possible applications of this two-colour device lie in the area of biosensing. For example, the new Si based light source could be used in the fast and cost-effective point-of-care analysis in health and environmental protection. (Source: FZD)

[7] phys. stat. sol. (c) **2**, 2941 (2005).
[8] Appl. Phys. Lett. **90**, 181121 (2007).

News in brief

➔ **"Wavy" silicon** has been introduced by the research group of John Rogers from the University of Illinois at Urbana-Champaign. By applying sheets of Si to a stretched rubber sheet, the silicon can be buckled into herringbone patterns in two directions by releasing the tension on the underlying rubber [9].



[9] Nano Lett. **7**, 1655 (2007).

➔ **Narrow-bandwidth photodetector:** A photosensitive layer of non-polar GaN on $LiAlO_2$ substrate forms a new device with only 6 nm bandwidth. It has been designed by S. Ghosh, H. T. Grahn et al. from PDI Berlin, UPM Madrid, and Tata Institute Mumbai for real-time identification of biological and chemical agents in air which produce UV fluorescence at 360 nm [10].

[10] Appl. Phys. Lett. **90**, 091110 (2007), phys. stat. sol. (c) **4**, 86 (2007).

➔ **Diamond quantum computer:** M. V. Gurudev Dutt, F. Jelezko et al. [11] from Stuttgart University have demonstrated qubit operation in diamond based on the nitrogen–vacancy colour centre. The defects were produced by nitrogen ion implantation [12].

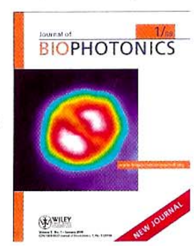
[11] Science **316**, 1312 (2007).
[12] See also the Review Article in phys. stat. sol. (a) **203**, 3207 (2006).

➔ **Magnetic racetrack:** G. Meier et al. from the University of Hamburg have demonstrated fast motion of a magnetic domain wall through a ferromagnetic permalloy wire. Nanosecond electric current pulses induced a speed of 110 m/s as imaged by polarized X-rays [13].

[13] Phys. Rev. Lett. **98**, 187202 (2007).

➔ The US National Science Foundation has chosen **Peidong Yang** from the University of California, Berkeley, to receive the 2007 Alan T. Waterman Award for his pioneering research on nanowires.

➔ The Julius Springer Prize for Applied Physics 2007 went to **Stefan Hell**, MPI for Biophysical Chemistry Göttingen, for his revolutionary discovery of resolutions far below the diffraction limit in fluorescence microscopy. Hell is Editor of the new Wiley Journal of Biophotonics to be launched in 2008.



➔ The new book "Brilliant!" by Bob Johnstone (Prometheus Books) tells the story of **Shuji Nakamura**, the Japanese engineer who laid the foundation for today's solid-state lighting revolution with his blue, green, and white LEDs and laser diodes [14].

[14] See, e.g., phys. stat. sol. (RRL) **1**, 162 (2007) (current issue).