# Self-organization of Semiconductor Nanostructures and their Application to Fabricate Nanomagnet Arrays

Christian Teichert

*Institute of Physics, University of Leoben, A-8700 Leoben, Austria*

**Abstract.** Spontaneous pattern during epitaxial growth or ion erosion of semiconductor substrates opens an elegant and efficient route towards fabrication of large-scale arrays of uniform semiconductor nanostructures. In semiconductor heteroepitaxy, strain-induced self-organization results in a wide spectrum of nanofaceted surface patterns as will be briefly reviewed for the Stranski-Krastanov growth of SiGe films on vicinal Si(001) [1]. Also ion erosion may result in well ordered semiconductor nanostructures, for compound semiconductors namely in close-packed arrays of hemispherical nanostructures [2]. By bombarding self-organized SiGe films, it is shown that periodic nanopatterns can be transformed into the Si substrate [3]. Strain driven self-organization can also be observed in heteroepitaxial growth of organic thin films. As an example, the self-alignment of oligophenylene crystallites on various single crystalline substrates will be presented [4]. In particular for the growth of para-sexiphenyl on mica (001), we observe the spontaneous rearrangement of individual crystallites containing about 140,000 molecules into chains with micrometer length [5]. Also very recent AFM investigations of upright standing ZnO nanorods will be presented [6].

Since the inorganic self-organized nanostructure arrays cover the entire substrate, they can serve as large-area nanopatterned templates for subsequent deposition of magnetic thin films [7]. This will be illustrated for the shadow deposition of cobalt onto self-organized, mesa structured SiGe films on the one hand [8] and on ion bombardment induced GaSb dot patterns on the other hand. X-ray magnetic circular dichroism measurements using a photoemission electron microscope (XMCD-PEEM) as well as magnetic force microscopy reveal that the resulting nanomagnets with lateral dimensions down to 30 nm are single domain.

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## REFERENCES

1. C. Teichert, *Phys. Rep.* **365,** 335 (2002).

2. T. Bobek *et al.*, *Phys. Rev. B* **68,** 085324 (2003).
3. C. Hofer *et al.*, *Nucl. Instrum. Meth.* B **216**, 178 (2004).
4. G. Hlawacek *et al.*, *Phys. Stat. Sol. A* **202**, 2376 (2005).
5. G. Hlawacek *et al.*, *Phys. Stat. Sol. A* **202**, 2376 (2005).
6. C. Teichert *et al.*, *Appl. Phys. A* **82**, 665 (2006).
7. G. Brauer *et al.*, *Nanotechnology*, in print.
8. C. Teichert *Appl. Phys. A* **76**, 653 (2003).
9. A. M. Mulders *et al.*, *Phys. Rev. B* **71,** 214422 (2005).