DS 6 Anwendung dünner Schichten

Zeit: Freitag 14:00–15:45 Raum: TU H110

Hauptvortrag

DS 6.1 Fr 14:00 TU H110

Strukturierung von dünnen Schichtsystemen auf EUV Photolithograpiemasken — •Jan Hendrik Peters — AMTC, 01109 Dresden, Rähnitzer Alle 9

Aussichtsreichster Kandidat in der Halbleiterindustrie für die Erzeugung von Chipstrukturen von 45 nm und darunter ist die EUV Lithographie. Bei einer Wellenlänge von 13.5 nm sind die herkömmlich verwendeten Maskenmaterialien nicht mehr transparent, so dass für EUV Photolithographiemasken auf neue Materialien ausgewichen werden muss. Hauptelement der Masken ist ein Multilagenspiegel von rund 280 nm Dicke aus 40 Doppellagen Mo und Si, welche die unter 6 Grad einfallende EUV Strahlung zu gut 65% reflektiert. Darüber werden weitere Schichten abgeschieden, die dem Schutz der Multilagen während der Nutzung (Capping Layer) bzw. während der Reparatur der Masken (Buffer Layer) dienen, sowie die eigentliche strukturgebende Schicht der Maske (Absorber Layer). Die Materialzusammensetzung und Dicken der Schichten werden durch die im Lithographieprozess benötigten optischen Eigenschaften der Maske bei 13.5 nm bestimmt, sowie durch die im Maskenherstellungsprozess verwendeten Strukturierungs-, Reparatur-, Reinigungs- und Messverfahren. In diesem Vortrag wird über die Verfahren zur Strukturierung von EUV Masken unter kommerziellen Rahmenbedingungen berichtet. Dabei wird nicht nur auf den Einfluss der Ätzverfahren auf die zu erreichenden Strukturgrößen und deren Uniformität über die Fläche der Maske eingegangen, sondern auch auf die Probleme beim Nachweis dieser Größen.

DS 6.2 Fr 14:45 TU H110

High resolution actinic defect inspection for EUVL multilayer mask blanks by photoemission electron microscopy — •U. Neuhäusler[1], A. Oelsner[2], M. Schicketanz[3], J. Slieh[1], N. Weber[3], U. Kleineberg[1], M. Brzeska[1], A. Wonisch[1], T. Westerwalbesloh[1], H. Brückl[1], M. Escher[3], M. Merkel[3], G. Schönhense[2], and U. Heinzmann[1] — [1]Fakultät für Physik, Universität Bielefeld, Postfach 10 01 31, 33501 Bielefeld — [2]Institut für Physik, Universität Mainz, Staudingerweg 7, 55128 Mainz — [3]Focus GmbH, Am Birkhecker Berg 20, 65510 Hünstetten-Görsroth

Photoemission electron microscopy (PEEM) is a widely used technique for the characterization of surfaces by photoelectron-imaging. As the development of extreme ultraviolet lithography (EUVL) progresses, PEEM becomes also important as a spatially resolving detector for "at-wavelength (13.5 nm)"metrology. We report here on the development of a new PEEM technique utilizing standing wave illumination near normal incidence at the actinic wavelength of 13.5 nm for inspection of buried defects in MoSi-multilayer mask blanks for EUVL. Due to the small escape depth of photoelectrons of just a few nm, structures buried in a bulk sample normally cannot be seen in PEEM. However, in multilayer-coated mask blanks, the incident wavefield propagates several 100 nm deep to the MoSi-multilayer-substrate interface. Thus, wavefront distortions caused by defects can be probed with a PEEM depending on the node/antinode phase condition at the multilayer surface. Experimental results of visualizing programmed defects down to 50 nm size in multilayer test samples will be presented.

DS 6.3 Fr 15:00 TU H110

Ordered arrays of semiconductor nanoparticles using thin films of block copolymers as templates — •Dong Ha Kim, Xue Li, and Wolfgang Knoll — Max Planck Institute for Polymer Research, 55128 Mainz

In this presentation latest developments concerning the use of self-assembled block copolymers for nanofabrication are discussed. Simple routes to fabricate patterned inorganic semiconductor nanostructures are presented using block copolymer thin films as templates. Asymmetric block copolymers provide a novel route by which ordered arrays of nanocylinders aligned normal to the film surface are produced by one-step spin coating from solution. Here micellar monolayer films of poly(styrene-co-2-vinyl pyridine) block copolymer (PS-b-P2VP) and thin films of poly(styrene-co-ethylene oxide) block copolymer (PS-b-PEO) were employed as scaffolds to incorporate inorganic materials within the polar PVP and hydrophilic PEO domains. Highly dense arrays of hexagonally-packed silica, titania, and composite titania/gold dot arrays were fabricated by chemical vapor deposition (CVD) methodology. The lateral spacing, i.e. the center-to-center distance between the dots and the size of the dots, were fine tuned by controlling the molecular weight of the block copolymers and ralative amounts of inorganic precursors to the block copolymers. Such site-specific semiconductor dot arrays patterned on a nanometer scale can have widespread uses for sensory and optoelectronic applications.

DS 6.4 Fr 15:15 TU H110

UV-nanoimprinting: A potential method for the fabrication of 3D-photonic crystals — •Thomas Glinsner[1], Farnaz Ghods Isfahani[2], and Kurt Hingerl[2] — [1]EV Group; DI Erich Thallner Strasse 1, 4780 Schärding, Austria — [2]Universität Linz, Halbleiter und Festkörperphysik; Altenbergerstr. 69, 4040 Linz, Austria

This contribution presents results achieved in ultraviolet nanoimprint lithography (UV-NIL) recommending this process as a potential fabrication method for photonic crystals. In photonic crystals the periodic arrangement of two materials with dissimilar dielectric properties exhibits a band of forbidden frequencies for the propagation of light (photonic band gap). Several techniques for the fabrication of 3D photonic crystals were proposed. Among them can be found wafer bonding, silicon micromachining, self-assembly, two-photon absorption, 3D holography as well as subsequent sputtering, DUV lithography and etching of consecutive planes. UV-NIL offers a low cost opportunity for the fabrication of nm-scale pattern transfer in single or multiple step application if compared to mainstream optical lithography. This next generation lithography technique is using quartz glass stamps, fabricated by e-beam lithography, which can be repeatedly imprinted in spin-on materials layers on silicon substrates. A concept for the fabrication of the woodpile structure will be demonstrated as well as achieved results. The woodpile structure consists of aligned rods where every subsequent layer is rotated 90° above the former layer so that the fifth layer is exactly above the first one and the piles of the third shall be located exactly between the piles of the first row.

DS 6.5 Fr 15:30 TU H110

Polarization splitting based on planar photonic crystals — •Veronika Rinnerbauer[1,2], Johann Schermer[2], and Kurt Hingerl[1] — [1]Christian Doppler Labor für oberflächenoptische Methoden, Institut für Halbleiter und Festkörperphysik, Univ. Linz, Altenbergerstr. 69, A-4040 Linz, Austria — [2]Photeon Technologies, Kirchstr. 35, A-6900 Bregenz, Austria

Planar polarization splitting devices based on photonic crystal slabs have been developed, their main advantages being the planar design and their possible integration into PLCs.

Due to their inherent polarization sensitivity, photonic crystals offer convenient solutions on a length scale of several tens of micrometers in silicon-based or other high index material systems. In a 2D photonic crystal slab, the presence of a horizontal symmetry plane allows us to decompose the guided modes into TE-like and TM-like polarization states, which are even and odd with respect to reflections through this plane. In this contribution, we will show three different principles that exploit the polarization dependency of these guided modes.

The first principle is based on reflection and transmission at a photonic crystal interface. The second one uses a defect waveguide for one polarization, and free propagation through the photonic crystal for the other polarization. In the third principle, defect waveguides with polarization-dependent guided modes are used for both polarizations.

Results from numerical simulations will be presented, which show that polarization splitting is possible with high efficiency in photonic crystal slabs.