DS 13: Optical Layers: Basic Research and Applications

Time: Tuesday 9:30–11:30 Location: H 2032

Invited Talk DS 13.1 Tue 9:30 H 2032

Film Production Technologies — •Hans K. Pulker — Thin Film Technology, Institute of Ion Physics and Applied Physics, University of Innsbruck, Austria

Films of elements, alloys, composites, and chemical compounds can be formed on solid substrates by various wet and dry chemical and physical deposition technologies. Depending on the applied technique, depositions are performed on air or in environmentally controlled atmosphere, under reduced gas pressure or in vacuum. In this paper mainly physical vapour deposition (PVD) processes are considered, because they are the preferred technologies for film deposition in optics. Chemical vapour deposition (CVD) and wet chemical processes are important in only few variants for this purpose. PVD processes are performed under vacuum and are based principally on purely physical effects. Intentionally forced chemical reactions by adding reactive gas to the coating chamber are used to deposit stoichiometric chemical compound films in the reactive deposition process. The chemical reactivity is generally positively influenced by the presence of a gas discharge plasma. In modern ion and plasma processes, input of energy into the growing film by collision and momentum transfer of kinetically enhanced ions, atoms and molecules causes densification and improves besides optical quality also structural and mechanical film properties and environmental stability. All the processes are used to deposit coatings in the thickness range between few nanometers up to some microns. Single films or multilayers can be deposited homogeneously or with graded composition.

Invited Talk DS 13.2 Tue 10:15 H 2032

Innovative stationary and in-line sputter technologies for precision optical coatings — •Peter Frach, Hagen Bartzsch, Joern-Steffen Liebig, Joern Weber, and Volker Kirchhoff — Fraunhofer-Institut fuer Elektronenstrahl- und Plasmatechnik,Winterbergstr. 28, 01277 Dresden, Germany

In this paper different new concepts for precision optical and antireflective coatings deposited by reactive Pulse Magnetron Sputtering (PMS) are introduced. In the first part features of stationary coating technology using various reactive gases and gas mixtures will be explained. The precise control of gas flow and process conditions during reactive sputtering of a silicon target in a mixture of oxygen and nitrogen gas allows to deposit layer systems with stepwise or gradient variation of the refractive index. Examples of AR-coatings, rugate and different filters based on SixOyNz coatings could proof the required optical performance as well as several application relevant properties like low internal stress, low roughness, high stability at temperature and humidity changes and at high density laser pulses. The complete coating can be done highly efficient at only one deposition station without interruption of the plasma. In the second part of the paper a new in-line coating system for precision optics with very strict requirements on accuracy, thickness uniformity and reproducibility will be presented that is based on two highly stabilized Pulse Magnetron Sputtering stations and a precision substrate transport system combined with an intermediate in-situ measurement.

Invited Talk DS 13.3 Tue 10:45 H 2032

Novel Process Concepts for Ion Beam Sputtering Deposition — •Kai Starke[1,2], Henrik Ehlers[1], Marc Lappschies[1], Nils Beermann[1], and Detlev Ristau[1] — [1]Laser Zentrum Hannover e.V., Hannover, Germany — [2]Cutting Edge Coatings GmbH

The application of charged noble gas beams with high ion current densities is of special scientific and economic importance for the production of highest quality thin film coatings. The ion beam sputtering process is known for the production of functional coatings of extreme optical performance concerning spectral characteristics, optical losses and damage resistance. During recent years, a tremendous increase in layer thickness precision has been achieved on the basis of broad-band optical monitoring techniques. Even complex thin film designs such as thin film polarizers, multi-band fluorescence filters and chirped mirrors can be manufactured without trial coating runs. Furthermore, an innovative process adaptation allows for the composition of material mixtures by co-deposition of two dielectric materials. This technique opens the field of novel optical materials with tailored properties and new thin film designs strategies like Rugate-filters. E.g. for TixSi1-xO2-mixture coatings, a distinctly increased damage threshold for ns-NIR pulses and a higher temperature resistance have been observed.

DS 13.4 Tue 11:15 H 2032

Reproduction of natural structural colours in thin film coatings — •Mathias Kolle[1], Heather Whitney[2], Ulrich Wiesner[3], and Ullrich Steiner[1] — [1]Cavendish Laboratories, Department of Physics, Cambridge University, UK — [2]Department of Plant Sciences, University of Cambridge, UK — [3]Materials Science Department, University of Cornell, Ithaca, USA

For many organisms in nature intense and distinctive colours play an important role in inter- and intra-species communication. Thus striking colours are well developed in nature and the most impressive natural colours actually arise from micrometre- to nanometre-sized structures, which often consist of intrinsically transparent materials.

Most of the underlying physical principles that create colour from mere transparent materials are well understood and the challenge lies in applying them to create artificial replicas of natural structural colours.

Nature shows that outstanding colours result in general from a balanced combination of various optical effects. Likewise we aim to create coatings based on nature-similar structures that optimally exploit different optical effects such as multilayer interference, diffraction from lateral structures as well as fluorescence.

Efficient, simple procedures and a variety of polymers and inorganic materials are used and will be subject of this presentation. Such coatings promise a wide range of applications only to mention unique labels in security applications to protect for instance credit cards, passports or banknotes from forgery.