troscopy. Emphasis has been placed on pure Ag and combined Ag/Au nanoparticles.

DS 29.6 Thu 12:30 GER 37

**Metal Nanostructures bound to Dielectric Substrates for Plasmonic Applications** — •Marisa Mäder, Susanne Perlt, Markus Lippmann, Jürgen Gerlach, Thomas Höche, and Bernd Rauschenbach — Leibniz-Institut für Oberflächenmodifizierung e.V., Permoserstraße 15, 04109 Leipzig, Germany

Metal nanospheres, especially when arranged in a predefined way, facilitate surface plasmon related applications [1]. In this paper, a method called Diffraction Mask Projection Laser Ablation (DiMPLA) [2] is used to create such nanostructres. The straightforward method uses an Excimer laser pulse (KrF, 248 nm, 25 ns) whose intensity is laterally modified by a phase mask and subsequently demagnified (15x, 36x, 50x) by a reflective objective. Exposure of a thin metal film on a dielectric substrate leads to the formation of metal nanostructures. Dependent on the phase mask that is applied in the setup, the arrangement of nanospheres on the sample can be controlled as desired. It is even possible to create non-regular pattern arrangements. Dependencies of the nanospheres on different parameters and some first steps into plasmonic applications are presented in this paper.

[1] W. M. Saj, Optics Express 13, 2005, 4818
[2] M. Maeder et al., Phys. Stat. Sol. (RRL) 2, 2008, 34

# DS 30: Application of Thin Films I

Time: Thursday 14:15–16:00 Location: GER 37

DS 30.1 Thu 14:15 GER 37

**Extraction of nitride trap density distribution in SONOS (silicon-oxide-nitride-oxide-silicon) structures based on an advanced thermal emission model** — •Kerstin Bernert[1], Jonas Schönlebe[2], Christiane Oestreich[2], and Thomas Mikolajick[2] — [1]Forschungszentrum Dresden-Rossendorf, Bautzner Landstraße 128, 01328 Dresden — [2]Institut für Elektronik- und Sensormaterialien, Technische Universität Bergakademie Freiberg, 09599 Freiberg

As a result of continued scaling and the emphasis on low power and low voltage operation, silicon-oxide-nitride-oxide-silicon (SONOS) nonvolatile memory has received more attention recently. In this talk we investigate the charge decay characteristics of SONOS devices at elevated temperatures. Based on the thermal emission model as the dominant charge loss mechanism, the trap density energy distribution is determined. Furthermore, we present an advanced model which includes the influence of subsequent tunneling through the bottom oxide after thermal excitation in the conduction band of the nitride.

DS 30.2 Thu 14:30 GER 37

**Liquid Injection Atomic layer deposition of metallic Ru and $RuO_2$ thin films for electrode applications** — •Susanne Hoffmann-Eifert, Seong Keun Kim, and Rainer Waser — Forschungszentrum Jülich, IFF-IEM and JARA-FIT, 52425 Jülich, Germany

In this project we studied the liquid injection atomic layer (LI-ALD) deposition of metallic Ru and $RuO_2$ thin films for application as electrode layers. The new capacitors will be built up from ultra thin films of higher-k materials like $SrTiO_3$ or (Ba, Sr)$TiO_3$ in order to decrease the equivalent oxide thickness. In order to have a conducting metallic or oxide electrode available for 3D integrated capacitor structures, we investigated the ALD growth process for Ru/$RuO_2$ thin films in detail. In this study, $RuO_2$ films were deposited using traveling wave type ALD reactor. Tris(2,2,6,6-tetra-methyl-3,5-heptanedionato)ruthenium(III)(Ru(TMHD)3) dissolved in ethylcyclohexane was used as a metal source. The Ru-solution was pulse injected and evaporated in a vaporizer at a temperature of 200 °C. The growth behavior of the ALD Ru/$RuO_2$ films was studied as a function of the substrate temperature and the type of oxidant. The films were characterized with respect to their structural, morphological and resistance properties. Special interest is layed on the effect of the solvent on the oxidation state of the conducting Ru based thin films. A model is suggested which explains the different growth behavior of Ru/$RuO_2$ films in "bubbler-type"and LI-ALD-type processes.

DS 30.3 Thu 14:45 GER 37

**Liquid Injection Atomic Layer Deposition of Lead Zirconate Titanate Thin Films for Three Dimensional Ferroelectric Capacitor Structures** — •Susanne Hoffmann-Eifert[1], Takayuki Watanabe[1], Cheol Seong Hwang[2], and Rainer Waser[1] — [1]Forschungszentrum Jülich, IFF-IEM and JARA-FIT, 52425 Jülich, Germany — [2]Dept. of Materials Science and Engineering, Seoul National University, Seoul, Korea

In order to combine the functionality of ferroelectric oxides with semiconductor memory devices, thin films with a thickness in the range of about 10 nm have to be integrated onto 3D stack structures with lateral diameter of about 100 nm and a height in the micrometer regime. The thin films have to be homogeneous in thickness and in composition. A fully conformal deposition onto extreme 3D structures can only be achieved by means of an atomic layer deposition (ALD) process. Here, we present an approach by which uniform coverage of multi-component oxide films over complex structures can be achieved in both, the cation composition and the film thickness. Quaternary PZT films were deposited using a combination of liquid injection ALD steps of binary PbO, $ZrO_x$, and $TiO_x$ films. Pb$(TMHD)_2$, Ti(Oi-Pr)$_4$, and Zr$(DIBM)_2$, dissolved in ethylcyclohexane, and $H_2O$ were used as source materials. PZT films were grown on Pt or Ir-covered Si substrates at 240°C. A further annealing step after deposition was performed to crystallize the material. ALD-PZT films were grown onto 3D structures with homogeneous thickness and cation composition, even after crystallization.

DS 30.4 Thu 15:00 GER 37

**Effect of the interface roughness on the performance of nanoparticulate zinc oxide field-effect transistors** — •Koshi Okamura, Norman Mechau, Donna Nikolova, and Horst Hahn — Forschungszentrum Karlsruhe, Institute of Nanotechnology, Karlsruhe, Germany

Field-effect transistors (FETs) based on nanocrystalline inorganic materials have been attracting interests as a candidate for printable electronics. Nanocrystalline FETs take the advantage of compatibility with low-temperature and high throughput processes. However, the critical parameter of nanocrystalline FETs is the interface roughness between the nanocrystalline semiconductor and the insulator, where the channel of the FET is formed. Therefore, the correlation between the interface roughness and the performance of nanoparticulate ZnO FETs is systematically investigated. ZnO nanoparticles were dispersed in 2-methoxyethanol with stabilizer at a fixed concentration and processed by ultrasonic treatments. The agglomerate sizes were changed by the duration time, so that the resulting films had different degree of roughness at the interface. The FETs in the bottom-gate configuration were fabricated from suspensions, consisting of a Si substrate, a $SiO_2$ layer, a spin-coated nanoparticulate ZnO layer and Al source and drain electrodes. The FET with the lowest average roughness of 47.4 nm showed the best mobility of $8.4 \cdot 10^{-3} cm^2/Vs$. In contrast, the FET with the highest roughness of 70.6 nm showed two orders of magnitude lower mobility of $8.7 \cdot 10^{-5} cm^2/Vs$. These results indicate the strong correlation between the interface roughness and the FET performance.

DS 30.5 Thu 15:15 GER 37

**Influence of Stabilizers in ZnO nanodispersions on the FET device performance** — •Simon Bubel, Donna Nikolova, Norman Mechau, and Horst Hahn — Institute of Nanotechnology, Forschungszentrum Karlsruhe, 76021 Karlsruhe, Germany

In order to build printable inorganic electronic devices, semiconducting suspensions which can be processed at low temperatures and low-cost manufacturing techniques are needed. Stabilized suspensions made of zinc oxide nanoparticles were used to fabricate field-effect transistors (FETs) by spin coating. The performance of the devices is strongly affected by the nature and concentration of the compounds added to stabilize the nanodispersions. An increase of the field-effect mobility by more than one order of magnitude is observed by increasing the stabilizer concentration from 3 to 13 wt %. A further increase of the concentration above 13 wt % results in a decrease of the field-effect