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A combination system combining adsorption/photo electrochemistry/dialysis is investigated for the first time for the Pb2+ removal. The Pb2+ adsorption on the Algerian bentonite is studied in batch mode. The initial Pb2+ concentration, adsorption dosage, pH and temperature are optimized. The maximum removal is observed at pH 6 for a concentration of 100 mg.L\(^{-1}\) at 25 °C. The adsorption is fast with ~ 90% occurring within 40 min of contact time. The process is spontaneous and endothermic. The Langmuir model is successfully applied to fit the experimental data. Adsorption is a pre-treatment prior the reduction of Pb2+ by photo-electrodialysis. The remaining concentration is lowered by photo-electrodialysis below the threshold required by the water standards. The ion exchange membrane, configured as a horizontal electrode, is an essential part of the process. The membrane is polymerized from cellulose triacetate modified by poly-ethyleneimine and plasticized by 2-nitrophenyl pentyle ether. It is characterized by FTIR and thermal analysis TGA. After crossing the membrane, Pb2+ is reduced owing to its redox potential, suitably positioned with respect to CuCrO2-CB (Fig.1). Indeed, the electrons coming from illuminated Sr2Fe2O5-electrode move via the external circuit where they reduce Pb2+ to its elemental metal state. The photo-electrodialysis indicates that the combined system p-CuCrO2/membrane/n-Sr2Fe2O5 enhances considerably the electrons transfer and the diffusion flux of Pb2+. 35% of Pb2+ are photo-electrochemically reduced under artificial light. The rate conversion increases up to 86% under solar light.
SURFACE MORPHOLOGY OF THIN FILMS BASED ON GE-SI-SN MATERIALS AT DIFFERENT GROWTH CONDITIONS

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Compounds based on Ge-Si-Sn materials have attracted a particular attention due to the possibility of the Ge-Si-Sn application in the photonics, nanoelectronics and photovoltaics [1]. In addition to the changes in the electronic and optical properties, the presence of Sn on the surface increases the surface diffusion of adatoms [2] and also influences on the appearance of a series of superstructures which aren’t observed in the GeSi system.

Thin GeSiSn films in the wide range of compositions and thicknesses were obtained by molecular-beam epitaxy. The analysis of spatio-temporal distributions of the intensity of reflection high-energy electron diffraction (RHEED) patterns allows to identify the superstructure and beginning of the nanoisland formation. The mismatch of GeSiSn and Si lattices was varied up to 5%. Figure 1 shows the kinetic diagram of the GeSiSn growth under 2% mismatch. As a result the Sn segregation on the surface the series of superstructures was observed during growth of the Si film on the GeSiSn layer. The decrease of the growth temperature of Si layer contributes the inhibition of the Sn segregation and reduction of the Si film roughness covering the GeSiSn layer. Regularities of the formation of multilayer structures with quantum wells containing pseudomorphic GeSiSn layers have been investigated. Hence the synthesis of superlattices, structures with quantum wells or quantum dots and creation devices based on them can be carried out.

References
The effect of ultrasonic treatment (UST) on the defect structure of the Si–SiO₂ system by ESR spectroscopy and secondary ions mass-spectroscopy (SIMS) is presented. The non-monotonous dependence of the defect densities on the US wave intensity has been observed. The influence of the UST frequency on the ESR signal intensity of the defect centres depended on the defects type and structure and may be caused by vibrational energy dissipation which are a functions of defect’s centers type. The influence of the UST on the Si–SiO₂ interface properties depends on the oxide thickness and crystallographic orientation. The density of point defects and absorbed impurities at the Si–SiO₂ interface can be reduced and its electrical parameters improved by an appropriate choice of the UST and oxidation conditions.
CRITICAL METAL THICKNESS FOR THE SCHOTTKY BARRIER FORMATION:
SYNCHROTRON RADIATION PHOTOEMISSION STUDY OF AG ON P-GAAS(001)-2X4

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The Schottky barrier heights (SBHs) are a vitally important property of metal-semiconductor (M-S) interfaces as they govern the carrier’s transit across the junctions. The ability to control/tune the magnitude of the SBH of the MS interfaces, thus lowering the ohmic contacts, is critical for the advanced electronic and photonic devices. A correct method for SBH determination has been an issue for decades, and most importantly, it is a prerequisite to answer if metal and III-V semiconductors interfaces are Fermi-level pinned by high gap state densities.[1] Synchrotron-radiation photoelectron spectroscopy (SRPES) is one of the best tool for understanding the interfacial properties at the M-S interface because it can not only measure the evolution of the interfacial electronic structures but also directly determine the values of the SBH. Here, the interfacial electronic structure of Ag in-situ deposited on a pristine p-GaAs(001)-2x4 surface has been studied using SRPES. The freshly prepared GaAs reconstructed surface was grown by molecular beam epitaxy, and transferred for the SRPES study with its pristine surface being intact under ultra-high vacuum of 10^-10 Torr. The tunability of photon energies in the SRPES allows the data collection in reflecting most information for a thin metallic layer formation, which meets the need of current nano-scale electronic devices. As a result, initially, the Ag adatoms exhibit an atomic character, and transfer negative charges to the As-As dimers of the GaAs(001)-2x4 surface. The metallic behavior of the Ag overlayer emerges at thickness of 2.5 Å. The SBH of Ag/GaAs could not be properly determined until thickness of 5 Å, where the value is 0.39 eV. At this thickness, the ultimate change in band bending is achieved, and the GaAs stoichiometric ratio is preserved at the value of the clean surface. Beyond 5 Å, the elemental segregation of GaAs occurs and As diffuses into the Ag overlayer to form As-Ag bonds.

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References
The effect of ultrasonic treatment (UST) on the defect structure of the Si–SiO₂ system by ESR spectroscopy and secondary ions mass-spectroscopy (SIMS) is presented. The non-monotonous dependence of the defect densities on the US wave intensity has been observed. The influence of the UST frequency on the ESR signal intensity of the defect centres depended on the defects type and structure and may be caused by vibrational energy dissipation which are a functions of defect’s centers type. The influence of the UST on the Si–SiO₂ interface properties depends on the oxide thickness and crystallographic orientation. The density of point defects and absorbed impurities at the Si–SiO₂ interface can be reduced and its electrical parameters improved by an appropriate choice of the UST and oxidation conditions.

References
The effect of ultrasonic treatment (UST) on the defect structure of the Si–SiO2 system by means of electron spin resonance (ESR), selective etching, MOS capacitance technique and secondary ions mass-spectroscopy (SIMS) is presented.[1,2]. The non-monotonous dependence of the defect densities on the US wave intensity has been observed. The influence of the UST frequency on the ESR signal intensity of the defect centres depended on the defects type and may be caused by vibration energy dissipation, which are a function of defect centres type. The influence of the UST on the Si–SiO2 interface properties depends on the oxide thickness and crystallographic orientation. The density of point defects and absorbed impurities at the Si–SiO2 interface can be reduced and its electrical parameters improved by an appropriate choice of the UST and oxidation condition. UST is widely used in medicine, not only for diagnostic, but for cancer treatment too. UST influence on inorganic and organic materials have common properties. These allow to suggest that UST may be used in biotechnology for materials properties modification.

References
CONTINUUM MODELING OF CYCLIC GROWTH IN SGE/SI(001) HETEROEPITAXIAL SYSTEMS

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Integration of Ge (or SiGe alloys) on Si is appealing in order to exploit the superior optical and electronic performances of Ge maintaining the well-developed Si technology. This goal requires controlling the misfit strain arising from the lattice mismatch. Both elastic and plastic relaxation are possible and their interplay during the growth process is not yet fully understood.

A continuum growth model based on surface diffusion following gradients in the chemical potential is presented. The balance between elastic and surface energy, including substrate-wetting contribution provides a description of island growth following the well-known Asaro, Tiller and Grinfeld instability [1]. The typical Stranski-Krastanov growth modality, characterized by coherent islands on a wetting layer, eventually undergoing long-time Ostwald ripening is reproduced.

Here we extend this approach by including plastic relaxation via misfit dislocations. An energetic criterion is implemented to test the condition for dislocation injection during the evolution. Once the dislocation is introduced, its strain field, calculated exactly by finite element method, is added to the misfit strain in the further evolution, as shown in Fig. (1). This procedure is iterated, possibly leading to insertion of several dislocations.

As we shall show, dislocations alter the morphology of the growing islands, leading to an initial flattening of their shape as shown in Fig. (2). An interesting oscillating behaviour in islands height-to-base ratio is recognized as consequence of successive dislocations injection [2]. Such “cyclic growth” was experimentally observed more than 20 years ago [3], but not yet reproduced by a simulation tackling the temporal evolution of the system.

References
[2] F. Rovaris, R. Bergamaschini and F. Montalenti. (to be submitted)
ABSTRACT BOOK

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PHOTODEGRADATION OF METHYLENE BLUE ON THE BASIS OF SOLID COPPER BASED ON SOLID ZINC OXIDE

SMC - Semiconductor surfaces

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One of the most hazardous substances discharged with wastewater are dyes, especially industrial dyes which are used in many industrial sectors such as textile dyes, paper, leather, food and the cosmetic industries [1]. In fact, synthetic dyes play a major part in our life as they are found in the various products ranging from clothes, leather accessories to furniture. Most of these dyes are toxic and dangerous for the environment and their removal from wastewater is a major environmental challenge [2]. Many methods have been suggested to handle the dye removal from water. The elimination of methylene blue (MB), a cationic Xanthines dye is examined used photo-catalysis process. The degradation was carried out under visible light irradiation and used the heterojuction x% CuO/ZnO (x =5, 10) as photocatalyst. The materials were prepared by impregnation method and characterized by several techniques as XRD, FTIR, RD…etc. The catalyst was tested for the degradation of MB under visible light irradiation. BM solution with an initial concentration of 10 ppm was degraded after irradiation with visible light for 240 minutes.

The photo-catalyst 10% CuO/ZnO exhibited a better ability to photo-degradation (fig.1) compared to 5% CuO/ZnO under the same conditions as ZnO is active in the degradation of BM. So we can say that the catalyst efficiency increases with increasing the concentration of CuO. Note that ZnO alone does not degrade the BM he shows a very low photocatalytic activity [3]. The diagram energetic was drowning to improve the photo-catalytic activity of the heterojunction CuO/ZnO under irradiation.

References