

KEEMIA- JA MATERJALITEHNOLOOGIA TEADUSKOND
MATERJALITEADUSE INSTITUUT
TEADUS- JA ARENDUSTEGEVUSE AASTAARUANNE 2013

Struktuuriüksuse struktuur.

Materjaliteaduse instituut, Department of Materials Science

Instituudi direktor Enn Mellikov

- Füüsikalise keemia õppetool, Chair of Physical Chemistry, Andres Öpik
- Pooljuhtmaterjalide tehnoloogia õppetool, Chair of Semiconductor Materials Technology, Enn Mellikov
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Struktuuriüksuse teadustöö kirjeldus:

The regularities of formation of CZTS compounds of different composition in form of monograin powders was studied and effect of composition of technical parameters determined. SnS thin films were deposited by different physical and chemical methods and the influence of deposition parameters to the structure, phase composition and optical properties of films determined, The studies on the formation of ternary compound (CuInS₂) in the chemical spray pyrolysis process were performed. Thermal analysis studies with the help of the complex of thermoanalytical methods allows elucidate the mechanism of ternary compound formation in the spray process generally. The plasmonic resonance effect in TiO₂:Au films was studied. The other field of research was the development of advanced functional materials based on molecularly imprinted polymers (MIPs) for biosensing applications. The overall goal of the proposal is to create highly selective, robust and multiplexed MIP-based microbiochips for label-free sensing of biomolecules such as amino acids, peptides, proteins.

Struktuuriüksuse aruandeaastal saavutatud tähtsamad teadustulemused

The regularities of formation CZTS thin films in electrochemical deposition process were determined. The effect of replacement of Sn in CZTS compound by Ge was determined and optical properties of formed Cu₂Zn GeS₄, Cu₂Zn GeSe₄ determined. The effect of Au nanoparticle size on the position and width of plasmon resonance band in thin film TiO₂ and intensity of Raman bands was confirmed experimentally. New type hierarchical nanosized structures of ZnO were synthesised and characterised. The increase in open surface area of ca ten times has been attained, and the structures show excellent photocatalytic activity for purification of waste waters. The effect of chlorine on properties of CBD deposited CdS films as a component layer for CdS/CdTe solar cell has been studied and discussed..the study of electrical properties of all-layers-sprayed solar cells by direct and indirect current techniques conjointly optical methods allows understand the properties and limiting factors of sprayed solar cells with chalcopyrite absorbers. We have demonstrated a method of preparing the MIP-based ultra-thin film recognizing IgG. In this method IgG was covalently immobilized through a cleavable cross-linker followed by controlled electropolymerization of the monomer to yield an ultrathin polymeric matrix. The method allowed to form the film directly on a sensor transducer surface, which in turn enabled convenient real-time label-free detection of IgG.

Struktuuriüksuse kuni 5 olulisemat publikatsiooni aruandeaastal:

1. M. Kauk-Kuusik, M. Altosaar, K. Muska, M. Pilvet, J. Raudoja, K. Timmo, T. Varema, M. Grossberg, E. Mellikov, O. Volobujeva. Post-growth annealing effect on the performance of Cu₂ZnSnSe₄ monograin layer solar cells. *Thin Solid Films* 535 (2013) 18-21.
2. A. Tretjakov, V. Syritski, J. Reut, R. Boroznjak, O. Volobujeva, A. Õpik, Surface molecularly im-printed polydopamine films for recognition of immunoglobulin G *Microchim Acta* (2013) 180:1433–1442
3. T. Dedova, M. Krunk, I. Oja Acik, O. Volobujeva, A. Mere, D. Klauson Hierarchical nano-structures of ZnO by spray pyrolysis, **Journal of Materials Chemistry and Physics**, 141 (2013) 69-75
4. Raadik, T.; Gossberg M.; Raudoja, J.; et al. JOURNAL OF PHYSICS AND CHEMISTRY OF SOLIDS Volume: 74 Issue: 12 Pages: 1683-1685
5. J. Lehner, M. Ganchev, M. Loorits, N. Revathi, T. Raadik, J. Raudoja, M. Grossberg, E. Mellikov, O. Volobujeva. Structural and compositional properties of CZTS thin films formed by rapid thermal annealing of electrodeposited layers. *Journal of Crystal Growth* 380 (2013) 236-240.

Loetelu struktuuriüksuse töötajate rahvusvahelistest tunnustustest

<i>Enn Mellikov</i>	<i>Eesti Vabariigi esindaja EL koostöövõrgus MEERA</i>
<i>Olga Volobujeva</i>	<i>Eesti Vabariigi teadusekspert EL koostöövõrgus MEERA</i>
<i>Maarja Grossberg</i>	<i>Eesti Vabariigi esindaja EL koostöövõrgus EERA-PV</i>
<i>Dieter Meissner</i>	<i>Eesti Vabariigi esindaja koostöövõrgus PV-Baltic</i>

Loetelu struktuuriüksuse töötajatest, kes on välisakadeemiade või muude oluliste T&A-ga seotud välisorganisatsioonide liikmed.

<i>Enn Mellikov</i>	<i>EL koostöövõrgu MEERA juhtkomitee liige</i>
<i>Olga Volobujeva</i>	<i>EL koostöövõrgu MEERA teaduskomitee liige</i>

Aruandeaastal saadud T&A-ga seotud tunnustused

<i>Enn Mellikov</i>	<i>EV teaduspreemia pikaajalise tulemusliku teadustöö eest</i>
<i>Anderes Õpik</i>	<i>valiti EV Teaduste Akadeemia liikmeks</i>