Research Team name: NanoTex / CollSynth

Presenter name: dr Zoran Šaponjić / dr Mirjana Čomor

Team Presentation – Annual Workshop, COST Action MP1106
Dublin, September, 2012

Team's general info

Research Team Name: NanoTex

- ♦ Vinča Institute of Nuclear Sciences, University of Belgrade, Serbia
- ♦ Textile Engineering Department, Faculty of Technology and Metalurgy, University of Belgrade, Serbia

Number of team members: 10

- ♦ synthesis and characterization of various nanomaterials using colloidal chemistry methods (polar solvents); metal (Ag, Au) and metal-oxide nanoparticles (TiO_2)
- ♦ synthesis and characterization of nanocomposites based on polymers and nanoparticles;

- ❖ 3 Chemists
- ❖ 7 Chemical Engineers

1 Professor; 1 Assoc. Professor; 2 Principal Research Fellows; 1 Senior Research Associate; 2 Post doctoral fellows ; 3 Ph.D. students

Research Team Name: CollSynth

- ♦ synthesis and characterization of nanoparticles in polar solvents: II-VI, IV-VI semiconductor and three-component systems I-III-VI_2

Number of team members: 5

- ❖ 5 Chemist

- 2 Principal Research Fellow
- 1 Senior Research Associate
- 1 Research Associate
- 1 Ph.D. students

Relevance to MP1106

Research interests related to MP1106 :

- the **role of surfactants** (influence on crystal phases, shape and dimension of nanoparticles in the synthesis of semiconductor nanoparticles (I-III-VI_2)
- **deposition** of colloidal nanoparticles (metal, metal oxides,….) on different surfaces (polymers, glass) using various techniques (dip coating, spin coating, etc.)
- **modification/activation** (surface engineering) of polymer surface (textile fibre), by corona discharge at atmospheric pressure and air/O_2 RF plasma at low pressure prior to deposition of nanoparticles; -target: improvement of binding efficiency
- **fibers** ((*cellulosic(cotton)*, *polyester* (PES), PES/alginates(natural anionic polysaccharide), *polyamide*)) **coatings** with colloidal TiO_2 and Ag nanoparticles;
- engineering the **multifunctional** textile **nanocomposites** (bactericidal activity, UV protection, self-cleaning (photocatalysis);

Lab description

Basic facilities, equipment, devices etc:

- Nicolet™380 **FT-IR spectrometer** with Smart Orbit ATR accessory Thermo Electron Corporation, Madison, U.S.A.
- **UV/Vis Spectrophotometer**, Evolution 600, Thermoscientific
- **Spectrophotometer**, Spectraflash 300, Datacolor
- **Fluorescence spectroscopy**
- **Contact angle meter** Drop Shape Analysis System, DSA 100, Krüss, Germany
- **Beaker dyeing apparatus** Mathis Polycolor M80, Werner Mathis AG, Switzerland
- **Pneumatic Padding Mangle** Vertical type P-A1, Gate AG Vaduz, Lichtenstein
- **Corona treater** Vetaphone CP-Lab MK II, Vetaphone, Denmark
- **Atomic Force Microscope** Quesant/Ambios corporation, U. S. A.
- Access to **SEM (Scanning Electron Microscopy), TEM (Transmission Electron Microscopy)** and **AAS (Atomic Absorption Spectroscopy)** at the University of Belgrade and University of Novi Sad, Serbia

Projects

#1 project :

Title: Materials of reduced dimensions for efficient light harvesting and energy conversion

-surface modification of natural and synthetic textile fibres with biopolymers (alginate) or polysaccharides (chitosane) and TiO_2 nanoparticles or Ag nanoparticles.

-the use of enzymes in surface modification of synthetic fibers

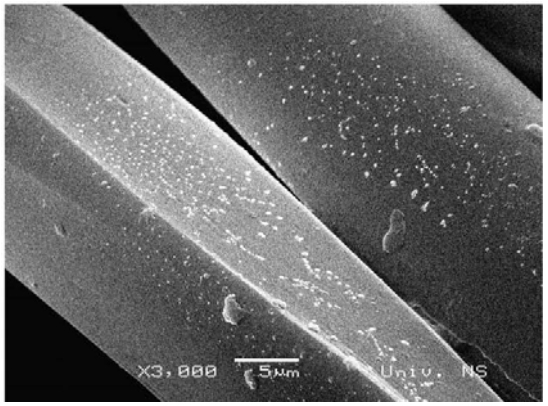
Duration: 4 years, until 2014th

Funding organization: Ministry of science, education and technological development of the Republic of Serbia

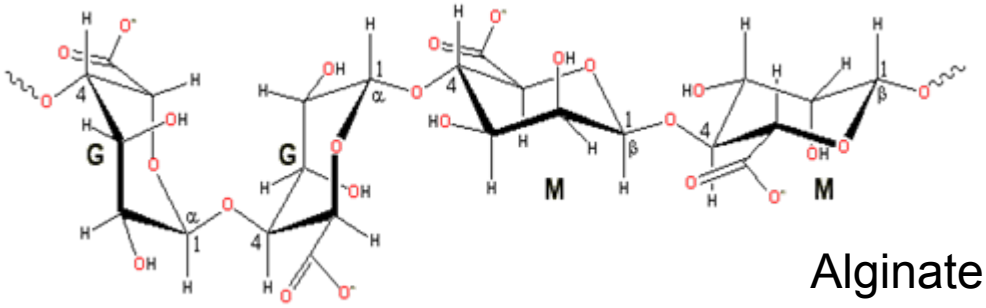
People involved and their function*: 5 PhDs, 2 postdocs, 3 PhD students*

Most interesting results:

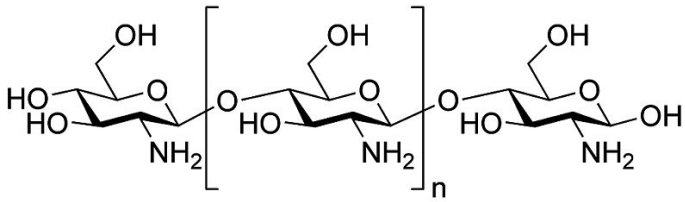
♦ Mihailovic et al., Functionalization of polyester fabrics with alginates and TiO_2 nanoparticles, *Carbohydrate Polymers* 79 (2010) 526–532.



SEM image of TiO_2 NPs on the PES fiber surface modified by alginate biopolymer



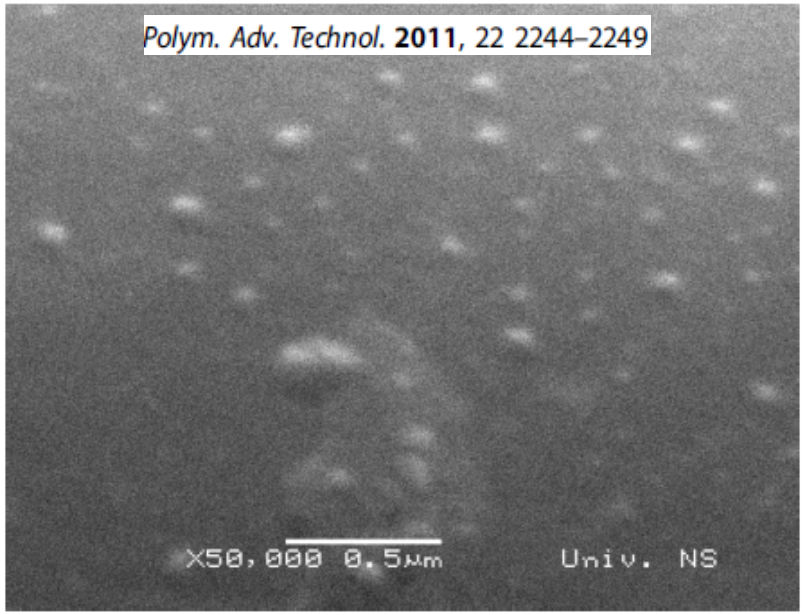
Alginate



Chitosan

♦ Mihailovic et al., Multifunctional PES fabrics modified with colloidal Ag and TiO_2 nanoparticles,

Polym. Adv. Technol. 22 (2011) 2244–2249.



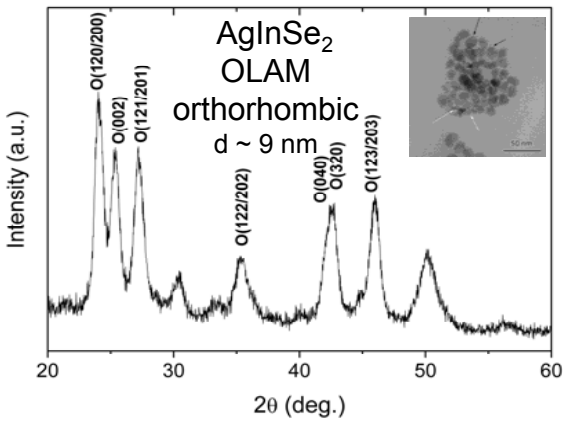
SEM image of the PES/Ag/TiO_2 fibre

Projects

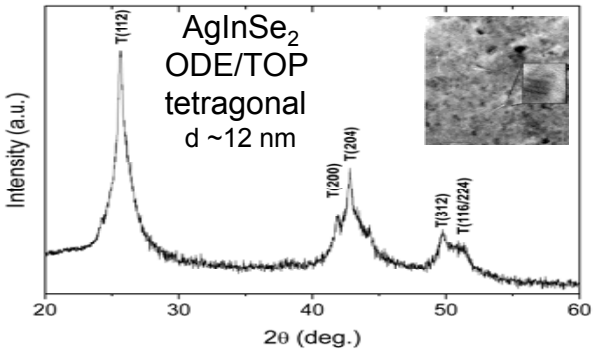
#2 project :

Title: Size, shape and structure dependence properties of nanoparticles and nanocomposites

♦ subject: examine the influence of ligands (TOP, oleylamine (OLAM)) on crystal phase and size of I-III-VI_2 nanoparticles



Abazovic et al., Ligand Mediated Synthesis of $AgInSe_2$ Nanoparticles with Tetragonal / Orthorhombic Crystal Phases, *J. Nanopar. Res.*, 14 (2012) 810



♦ subject: surface modification of synthetic textile fibers with Ag and TiO_2 nanoparticles and conducted polymers (*in situ* polymerization);

♦ purpose: creation of intelligent textile materials that perform antibacterial action, self cleaning effect and possess anti-electrostatic properties.

♦ the understanding of the interaction between nanoparticles, conducted polymers and textile fibers is of basic importance in synthesis of such nanocomposite systems.

Duration: 4 years, untill 2014th

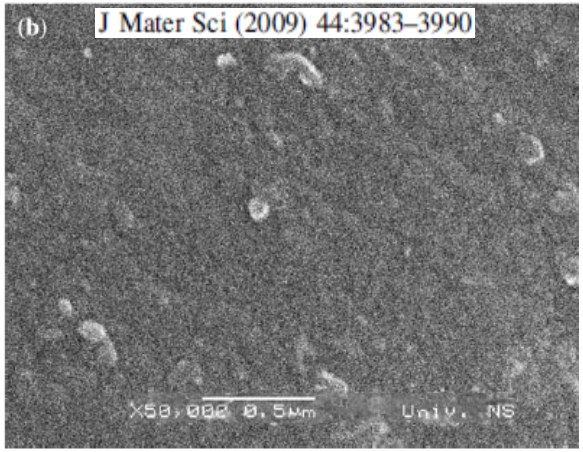
Funding organization: Ministry of science, education and technological development of the Republic of Serbia

People involved and their function: *9 PhDs, 2 postdocs, 4 PhD students*

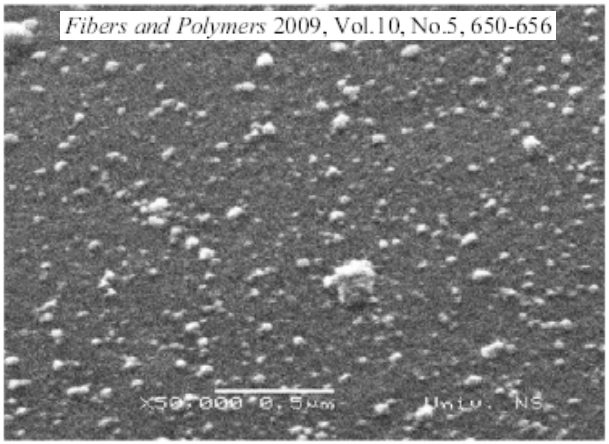
Topics for Research Proposal

#1 Topic

Title: Controlled functionalization of fibers (textile) surface with metal and metal oxide colloidal nanoparticles



SEM image of Ag loaded CPA fibres



SEM image of Ag loaded CPES fibre

Duration: 3-4 years

Expertise required: surface chemistry, polymer physics,..

Facilities/equipment required: XPS, SEM/FESEM, AFM,…

- binding efficiency of nanoparticles and fiber surface is a bottleneck in processing of this type of composites and therefore stability and durability of such materials is still under the question.

- engineering of desirable fiber surface so-called surface tailoring, from the standpoint of its functionality, in combination with well known surface characteristics of nanometer-sized metal and metal oxide particles can help to solve this problem

Topics for Research Proposal

#2 Topic

Title: Colloidal nanoparticles dispersions for manufacturing patterned surfaces for application in photovoltaic cells and photocatalysis

Promotion images & text :

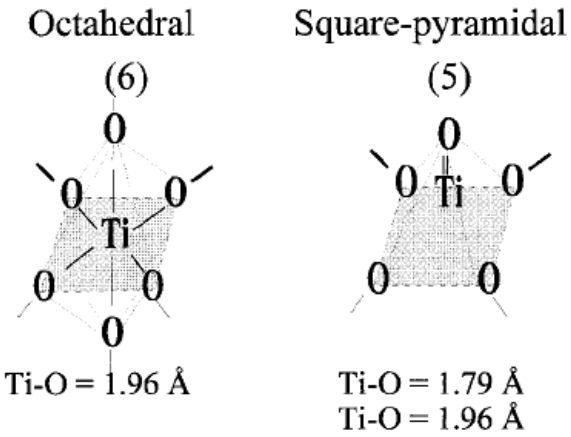
- Synthesis of nanoparticles with desired surface properties using new surfactants to control deposition on various substrates

- Viscosity

- Inkjet printing

-In nanosize regime (d < 20 nm) reconstruction of the surface of TiO_2 nanoparticles results in undercoordinated sites.

-Unique and selective reactivity of nanoparticles toward enediol ligands



J.Phys.Chem.B, 103(18), 3515, 1999

Duration (*if estimated*): 3 or 4 years

Expertise required: Colloid and interface science,..

Facilities/equipment required: HRTEM/TEM, XRD, Spectroscopies (XAS, Uv-Vis, FTIR), viscometers,..

Thank you for your attention