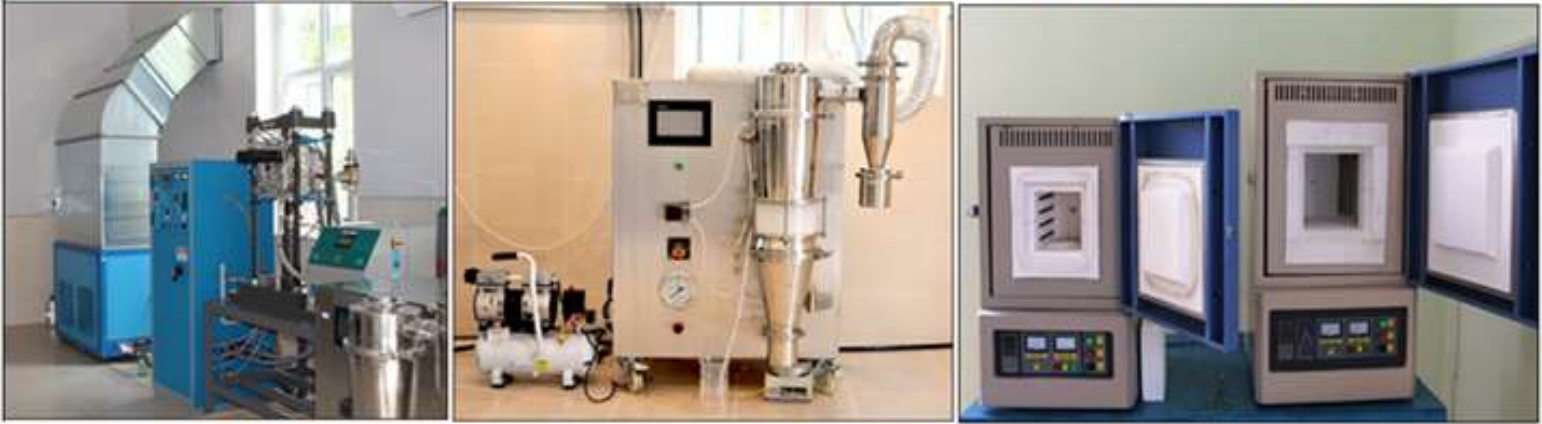


LABORATORY OF CHEMICAL TECHNOLOGIES



Laboratory Head: Dr.Roin Chedia

Scientific Direction: Development of ultra disperse multicomponent powders and on their basis matrix ceramic composites obtaining technology

Application of the new technologies give basis to modern scientific and technical progress and their further development. Nanotechnologies put way to new type materials with operating properties 2-3 times higher compared to ones obtained by traditional methods. Nanostructure materials are characterized by unique physics-mechanical and chemical properties achieved by controlling structure/properties at micro-level. Many countries invest billions of dollars to develop technologies for the obtaining of special purpose materials to solve many problems of the earth civilization (economic, socio-political, ethnic and religious conflicts, energy, environment, health, water and protein deficiency problems, agriculture, etc.). Georgia does not produce products based on nanotechnology methods. Basic problem is selection of the research objects and their adjustment with the local raw materials. In this regard, the Institute raised practical tasks, solving of which will bring its share in the Country's welfare and highly increase possibilities for innovative materials introduction. Chemical Technologies Lab was established in 2012. Major task of the Lab is to obtain ultra-disperse power composites from local raw materials based on the advanced (nanotechnology) methods and to fabricate ceramic materials by their high temperature sintering. One of the widely used oxide ceramic appear corundum. Resources available in Georgia (Aluminum silicates, industrial waste, scrap aluminum) are fully sufficient for the obtaining of ultra-disperse aluminum oxide and fabricating various functional assignment ceramic items. The Lab is involved in works aimed at obtaining press powders, which basic content is aluminum oxide particles sized: 50-200 nm and oxide and non-oxide inorganic compounds (ZrO_2 , MgO , Y_2O_3 , SiO_2 , B_4C , WC , TiC , ZrB_2 , BN , etc.).

With support of Georgian Government, International aids, International Partnership Programs and Grants, Shota Rustaveli National Science Foundation and State Military Scientific-Technical Center Delta, Ilia Vekua Sukhumi Institute of Physics and Technology (SIPT) managed to set up Composites Consolidation Lab. The Lab is equipped with modern high temperature vacuum furnace, containing hot press system (OXY-GON, USA). Below is listed significant results achieved during 3 years work, despite the small amount of employees:

- Ultra disperse aluminum oxide powders are obtained by adjusting world experienced technologies to local raw materials (aluminum silicates, aluminum scrap) with their appropriate corrections;
- Several methods for alfa-aluminum oxide obtaining are developed from metal alumina powder and their compounds;
- A study of aluminum instable oxides and hydroxides low-temperature transformation into alpha-form by various dopants;
- Powder composites are sintered by traditional method, spark-plasma synthesis, in the induction and vacuum furnace hot press method;

- Developed various type matrix ceramics obtaining technology (based on oxide and non-oxide matrixes);
- Special attention is drawn to powder composites and ceramic items chemical and phase analysis, structure-morphologic research and physics-mechanical characteristics determination;
- Intensive works are underway to obtain new type hybrid ceramic materials reinforced by the structures resulted by carbon materials synthesis (graphite and graphene oxides, graphene, nanotubes); at this stage obtained is graphene and aluminum oxide containing powdery composites;
- Various functional ceramic materials ordered by Georgian Scientific-Research and State Institutions are fabricated based on scientific-technologic works conducted with the OXY-GON furnace.

Ecological direction: Removing heavy metals from water using nano zero valent iron containing reactive barriers

At present, the Lab is involved in scientific-research works, which major objective is creating multi-functional complex sorbents allowing simultaneous removal of heavy metals, radionuclides and pollutants from water. Methods of nano zero valent immobilization in biopolymers and inorganic backgrounds methods are already developed. In the immobilized systems, heavy metals are absorbed by the matrix either and the thus decreasing costs on the active component-nanoiron. Methods for obtaining various content organic-inorganic hybrid sorbents are also developed.

- It is confirmed that sorbent is effective for heavy metals removal from waters and organochlorine pollutants decomposition;
- Methods of various modification aluminum oxide obtaining and on them nano zero valent iron powders immobilization;
- Granulated sorbent - $\text{Fe}^0/\text{Al}_2\text{O}_3$ and $\text{Fe}^0/\text{Fe}_3\text{O}_4$ are obtained by the powders granulation;
- Currently, scientific research works are conducted to fabricate optimal reactive barrier samples and mobile water purifying device.

Scientific Projects:

1. Project GNSF №CF/72/11-811/15 International conference grant, Advanced Materials and Technologies (ICAMT), 2015;
2. Project GNSF №30/36, Obtaining of ultra-dispersive alumina on basis of local resources and development of producing of corundum ceramic products. 2013-2015;
3. Project GNSF №41/07 High Temperature Vacuum Furnace and Pressing system (OXY-GON), 2013-2014.
4. Project P560 (Lawrence Berkley National Laboratory, U.S.A), Targets for High Temperature Superconducting Films. 2013-2014;
5. Project of USA Department of State: Smelting of TNT from artillery shells and mines, utilization, processing and disposal of guided and unguided aircraft rockets and their hazardous components. 2011-2012.

Staff:

1. Laboratory Head - Dr. Roin Chedia
2. Research Fellow – Tinatin Kuchukhidze
3. Research Fellow – Natia Jalagania
4. Research Fellow – Manana Mumladze
5. Engineer – Tamar Archuadze



Diffractometer DRON-3M;



High Temperature Furnace JYBF-1700.



Glove Box SG 1200/750Ts ;



Nano Mill PULVERISETTE 7 FRITSCH;



Granulator SD1000 ;



High Temperature Vacuum Furnace OXY-GON .



Analytical Scale FA/JA ;



Nanosizer Dynasizer Analysette 12 FRITSCH .



Optic Microscope NMM-800TRF;



Grinding Device ALLIED High tech products.

Various ceramic items made in the Lab:

