

## **Sub-theme 3.2. Advanced Material Research and Development**

### **Rationale**

Advanced material research aims at producing novel materials at macro-micro- and nano scales that have a spectrum of applications in many areas of applied sciences and engineering. Nanoscale science, engineering, and technology, which are widely and collectively termed as ‘nanotechnology’, is an emerging multidisciplinary field that can have enormous potential on impacting the society. Research in this sub-theme will lead to significant advances in a variety of applications including medicine, material science, agriculture and food, computing and electronics, industrial manufacturing, environmental remediation, energy production, and military applications, among others.

### **Aim**

The aim of this sub-theme is to synthesize/fabricate and develop novel materials in macro/micro/nanoscale that have applications in areas such as energy and environment, agriculture and food, health and medicine, engineering, electronics and IT.

### **Description**

This sub-theme focuses on the synthesis, fabrication, and device development of novel materials such as polymers, composites, hybrids, semiconductors, ion exchangers, sorbents, coordination/organometallic compounds that have unique optical, magnetic, electrical, structural, mechanical, thermal, and other important functional properties. The functional properties are meant for development and production of solar cells, photo catalytic degradation of organic and inorganic pollutants, separation science and technology (sorption, exchange), sensor, and various other applications.

### **Potential Collaborators**

Domestic and overseas universities, Ministry of Science and Technology, Environmental Protection Agency, Ethiopian Standards and Quality Authority, etc.

### **Expected Output**

- Advanced materials and nanotechnologies for greener and better energy alternatives, better health and environment, and improved agricultural productivity and food packaging and delivery system.
- Better understanding and broadening of knowledge on nano-sciences and nanotechnologies
- Strengthening postgraduate education and research capacity on nano-sciences and nanotechnologies.

### **Research Areas**

#### **3.2.1. Fabrication/development and applications of nanomaterials and nano device**

This research area focuses on nanoscale materials, which are promising candidates for improvements in alternative energy. The research area also deals with nano science technology for cleaning air, water, and soil through photo catalysis, sorption, ion exchange, nano filtration and others, nano systems for drug delivery systems, nano particulate antimicrobial coatings involving silver nanoparticles for wound care, nano emulsion, nanomaterials in food packaging and agrochemicals to deliver pesticides/herbicides. It also involves enhanced use of nanotechnology in glass, concrete, and steel technologies, in coatings such as paints to give the coating self-healing capabilities and corrosion protection under insulation, and nanomaterials in optoelectronic, computing, and semi-conductor devices.

#### **3.2.2. Fabrication/development of bulk materials**

Research in advanced materials development is also involved in the synthesis/fabrication of novel bulk/macroscopic materials such as coordination compounds, ceramic materials, organometallics, semiconductors, alloys, composites, exchangers, hybrid materials and others

with tremendous applications that add convenience to our lives. These include antimicrobial/dyeing application, materials for separation/sensing technology, electronic materials (laptop computers, digital cell phones etc.), catalytic materials, materials for energy/gas storage, and others.

### **3.2.3. Monitoring and control of hazardous nanomaterials**

This research area focuses on validation of new advanced materials and nanotechnologies; assessment of the effects of advanced materials and nanotechnologies on human, animal and environmental health; standardisation of the products of advanced materials and nanotechnologies; control side effects of advanced materials and nanotechnologies; assess the impact of advanced materials and nanotechnologies on livelihoods; formulate policy guidelines for the production and utilisation of advanced materials and nanotechnologies.

#### **Beneficiary**

Scientific community, industries, agriculture, farmers, businesses, community at large