

## **Working Group for Polymer, Hydrogel, Application, Science, and Engineering (PHASE)**

**PHASE** is a research team of academics from Kadir Has University from Istanbul, Turkey, Piri Reis University (PRU, İstanbul-Turkey) and Trakya University (TU, Edirne -Turkey) who study the optical, mechanical, electrical, thermal properties of polymer composites and metal oxide films. The main role of KHAS is to carry out wet lab experiments. They conducted researches on the film formation doped nanoparticles, and activation energy and optical band gap energy of the films. These films are performed by X-Ray Diffraction (XRD), X-Ray Photoelectron Spectroscopy (XPS), Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), and Raman Spectroscopy. Research group from PRU is highly interested in optical and mechanical properties of composite polymers doped nanoparticles and polymer films. These parameters are conducted by UV, Fluorescence Spectroscopy, and INSTRON 3345 Mechanical Equipment. TU conducts in thermal and electrical properties of bulk and film forms of polymer composites. In addition, TU has some equipments such as Differential Scanning Calorimeter (DSC), Thermogravimetric Analysis(TGA), and Fourier Transform Infrared Spectroscopy, and Keithley Electrical Conductivity Measurement.

**The major objective of PHASE** is to understand bulk and film forms of polymer composites, to define their physical parameters such as diffusion coefficients, elastic modulus, optical behaviour, and electrical band gaps. Thus, new polymer composites and flexible electronic devices widely used in the industrial and maritime related fields.

**Our field of expertise** covers;

- 1) Bulk and film forms of polymer composites and optimization of polymerization conditions,
- 2) 'Material Testing' specifically optical, electrical, thermal and mechanical properties of polymer composites, and metal oxide films,
- 3) Sustainable development of new products with emerging two-dimensional material based, production of materials with variable energy band gap, device design with these materials and testing to apply to different areas.

### **Recent Successful Projects/Studies:**

The group leader has 344 articles published in SCI index, which are related to solid-state physics, fractal geometry; polymer physics, especially about latex film formation, polymer composites doped nanoparticles. Research group from KHAS highly interested in the film formation doped nanoparticles, and activation energy and optical band gap energy of the films. They conducted researches on the physical properties of the films obtained by combining the characterization with the metal oxide structures and the polymer materials (Pekcan, et al., 1999; Uysal, et al., 2015). In addition, his colleagues have more articles in SCI index about film formations, composite films and their phase transitions, optical, mechanical, thermal and electrical properties.

PRU is the first and only university of Turkey with a maritime theme and research group from PRU is experienced in the optical and mechanical properties of composites (Evingur and Pekcan, 2018; Evingur, and Pekcan, 2016). Research group from TU has expertise in effects of nanoparticles such as graphene nanoplate (GNP) addition on the electrical conductivity and optical absorbance of composite films (Arda, and Kara, 2018).

### **References**

1. Journal Of Colloid And Interface Science, Volume: 213, Pages: 160-168, 1999
2. Applied Surface Science, Volume 350, Pages 74-78, 2015.
3. Polymer Bulletin, Volume: 7, Pages: 1431-1439, DOI: 10.1007/S00289-017-2101-4, 2018.
4. Carbon Nanotubes - Current Progress of Their Polymer Composites, 125-153, DOI: 10.5772/63054, 2016.
5. Phase Transitions, Volume: 91, Pages: 546- 557, DOI: 10.1080/01411594.2018.1432053, 2018.

**Topics of Interest in H2020:**

We are interested in the calls BBI.2018.S03.R10, BBI.2018.S03.F1, DT-NMBP-03-2019, DT-NMBP-12-2019, DT-FOF-08-2019, DT-NMBP-18-2019, DT-NMBP-19-2019.

We aim to understand the behaviour of nanoparticles in the polymers and films used for industrial materials and maritime's application. One of the goals of our group is to bring international experts from industrial and maritime related fields and other fields together to understand polymer composites and flexible electronic devices related issues deeply and transfer know-how between partners which overlap with the goals of the H2020 calls.

**As an experienced project partner,** we can contribute to project development. PHASE can manage basic and applied research; bulk and film forms of polymer composites that can be realized and can be, applied the optimization of polymerization conditions. Besides the design and performance of flexible electronic devices; the morphological structure, thickness, optical, mechanical, thermal and electrical properties of polymer composites and films; basic physical properties as well as phase transition mechanisms, surface morphology to fractal dimension, structure growth kinetics can be examined in detail.

In addition, new structured polymers and metal oxide materials such as Titanium dioxide ( $TiO_2$ ) and Zinc oxide (ZnO) can be used to produce hybrid structures and can be analysed to their properties. Because, titanium dioxide is widely used as a pigment providing whiteness and opacity in food, cosmetic and pharmaceutical industries, paint, plastic and paper industries, and Zinc oxide is widely used in dyeing, rubber industry, rubber production, cosmetics, petroleum products, ceramics and glass products, and coating industry.

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