The selected Chicago-BGU projects (short abstracts from the funded proposals):

1. Timescale of groundwater transport: A prerequisite for geo-engineering. Recent progress in membrane technologies and molecular engineering has enabled effective inland brackish groundwater desalination and biochemical remediation of contaminated water resources. In order to engineer these processes most effectively in the environment, it is essential to understand, in addition to the principal physical/chemical/biological processes of interest, the behavior of water that hosts the reactions, along with specific groundwater flow trajectories. The proposed project will develop and apply tracers to investigate two aquifer systems that are important sources of groundwater exploitation in Israel. Each collaborating institution has unique expertise vital to the proposed project, including sampling and sample preparation (UChicago), noble gas radionuclide analysis (ANL) and hydrogeology (BGU). PIs: E. Adar, BGU, R. Yokochi, UChicago, Z.-T. Lu, ANL.
2. Self-assembled functional membranes for filtration and photocatalytic water treatment. We propose using a low-cost combination of block copolymer self-assembly and a novel technique called sequential infiltration synthesis to prepare nanoporous membranes with unique and tunable mechanical, filatration and catalytic properties. The confluence of distinctive fabrication expertise among the ANL and BGU researchers and infrastructure enables this innovative approach, which will serve as a seed effort to establish strong industrial connections. Objectives: Develop a process to fabricate nanoporous titania with controllable pore size; Characterize mechanical, filtration and catalytic properties of these membranes; Create an effective low-cost membrane for purifying water process streams from hazardous organic materials; Initiate relationships to transfer this technology to a commercial setting. PIs: S. Darling, ANL & UChicago, J. Elam, ANL, R. Bitton, BGU.
3. Fundamental understanding of biofouling control by zwitterionic polymer brushes: Interactions between bacteria and ultralow fouling surfaces. This proposal is to evaluate how changes in aquatic environmental conditions affect the structure, elestic properties, degree of swelling and anti-fouling characteristics of new membrane coatings based on ionic polymer brushes. Objectives: Synthesize a series of ionic polymer brushes of varying molecular weight, aiming for modified surfaces with the smallest polymer that provides optimal anti-fouling; Evaluate the structure, swelling and viscoelesticity of these layers under different salt and pH conditions. Evaluate these coatings for the attachment of bacteria and secretion of extracellular adhesion molecules by the bacteria. PIs: M. Herzberg, BGU, M. Tirrell, UChicago, M. Gottlieb, BGU.
4. Catalytic wet oxidation of organics in water with soluble oxidants and nanostructured Au/TiO2 materials. This project aims to clarify the surface phenomena that occur during catalytic wet oxidation of organic contaminants in industrial waterwater using the nanocrystalline Au/TiO_2 system and soluble oxidation agents _ hydrogen peroxide and persulfide. This is the only solid catalytic system presently known that combines highly efficient mineralization of dissolved organics with absolute leaching resistance in a wide range of pH. The research team includes specialists with comprehensive expertise in development of novel catalysts, application of modern surface characterization techniques, and theoretical calculations, together with evaluation of catalyst performance and selction of the optimal reactor configuration and operating conditions required to meet commercial needs. PIs: M. Herskowitz, BGU, M. Landau, BGU, S. Sibener, UChicago, D. Talapin, UChicago.
5. Membrane-biofilm nexus: Advanced membrane autopsy as a tool for revealing membrane biofouling and development of new membrane materials and structures. The interdependency of water and energy requires development of cost-effective water treatment technologies. Membrane biofouling is a major obstacle in application of membrane purification processes for water. We will dvelop tools to evaluate and understand microbial community structure in biofilms formed on membrane materials. These tools will enable us to diagnose and predict, and ultimately, prevent and control membrane biofouling. This will be a template for solving problems in other water treatment process and addressing public health concerns associated with microbial contamination of water. PIs: J. Gilbert, UChicago & ANL, S. Snyder, ANL, M. Urgun-Demirtas, BGU, C. Arnush, BGU.