

Project #03R: **Barbara Boyan** and **Haifeng Chen**: *Biomimetic Scaffolds for Bone Tissue Regeneration*

Our overall goal is to develop materials for tissue engineering applications that control cell behavior through structural signaling without the need for pharmacologic modification. We have recently completed collaborative studies showing that human mesenchymal stem cells (HMSCs) will differentiate into osteoblasts when grown on electrospun nanofiber TiO<sub>2</sub> scaffolds with micropatterned surfaces, even in the absence of osteogenic supplements in the media (BME/PKU student Xiaokun Wang and Bioengineering student Rolando Gittens, et al.). In related work in the Georgia Tech lab, we have developed polymers of varying stiffness. Using a cell culture model in which HMSCs are grown on disks of the polymers, we showed that osteoblastic differentiation is stiffness dependent. The purpose of this proposal is to determine if osteogenic responses to micro and nanoscale structure and stiffness can be maintained in three dimensional cultures, by developing electrospun scaffolds using these polymers. This project will involve the expertise in the Haifeng Chen laboratory at PKU, where the electrospun scaffolds will be produced and their three dimensional structure determined using transmission and scanning electron microscopy. In addition, the stiffness properties of the scaffolds will be determined using atomic force microscopy. Cell culture studies will be performed by BME PhD student Erin Hewett in the Barbara Boyan laboratory using HMSCs. In addition, the Boyan lab will characterize the surface properties of the polymer scaffolds with respect to chemical composition. Finally, scaffolds will be implanted in rat tibial metaphyseal bone defects at Georgia Tech and bone healing assessed histologically (PKU) and by microCT (GT). The results of this project will provide important new information about the role of surface properties, including nanostructure and stiffness, on how endogenous multipotent cells can be recruited to tissue engineering scaffolds in vivo and form bone, without the need for peptide modification of the biomaterial.