Millions suffer from often debilitating bone injuries and diseases each year. Often, defects remain which must be treated to restore original function to the bone. Development of tissue engineering as a bone regeneration option requires identification of a suitable osteoconductive matrix. Hydrophobic scaffolds such as poly(propylene fumarates) and polyanhydrides have shown promise as osteoconductive matrices, and recently, hydrophilic polyethylene oxide (PEO) hydrogels to which cell adhesion ligands have been conjugated were demonstrated to provide an osteoconductive environment. Based on these results, scaffolds in which the level of hydrophobicity can be tuned may be particularly desirable for optimizing the formulation of bone tissue engineering matrices.

In the present study, we characterize the effects of novel inorganic-organic hydrogel scaffolds generated by the photo-cure of star polydimethylsiloxane ($PDMS_{star}$) (hydrophobic inorganic polymer) and linear hydrophilic PEO on rat osteoblast extracellular matrix (ECM) production, alkaline phosphatase expression, and calcium deposition. Initial studies have shown these hybrid scaffolds to display a range of hydrophobicities as well as microstructural, biochemical, and biomechanical properties that can be precisely tuned over a broad range.

By varying the ratio of $PDMS_{star}$ to PEO, the modulus of the hydrogels remained constant. However, gradual alterations in hydrophobicity and microscale scaffold morphology were introduced. These alterations in morphology impacted cellular ECM production and calcium deposition. Specifically, cells demonstrated a moderate increase in collagen type I, osteocalcein, and alkaline phosphatase as hydrophobic $PDMS_{star}$ levels increased from 0 to 1%. However, production of these same markers fell dramatically as hydrophobicity increased beyond this point. Similarly, the levels of collagen and GAG production varied significantly with hydrogel $PDMS_{star}$ concentration. Thus, by modifying the composition of novel inorganic-organic $PDMS_{star}$:PEO hydrogels, we are able to modulate the ECM production and differentiation of encapsulated rat osteoblasts. Future investigation of the impact of systematic alterations in the microstructural, biochemical, and biomechanical properties of these hybrid scaffolds on cell behavior should therefore yield profound insight into the dependence of cell behavior on material properties.