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MICRO/NANO-ENGINEERING OF MATERIAL SURFACES FOR TISSUE ENGINEERING AND REGENERATIVE MEDICINE

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Surfaces that contain micro- and nanoscale features in a well-controlled and “engineered” manner have been shown to significantly affect cellular and subcellular function of various biological systems. Our research is focused towards using the tools of micro- and nanotechnology for application in biomaterials and tissue engineering. The goal of current research is to design implants that induce controlled, guided, and rapid healing. In addition to acceleration of normal wound healing phenomena, these implants should result in the formation of a characteristic interfacial layer with adequate biomechanical properties. To achieve these goals, however, a better understanding of events at the tissue-material interface is needed, as well as the development of new materials and approaches that promote biointegration. Our work proposes the use of well-controlled nanostructured interfaces to enhance implant integration. We hypothesize that controlled nanoscale architectures can promote cell differentiation and matrix production, and enhance short-term and long-term integration. Moreover, the ability to create model nano-dimensional constructs that mimics physiological systems can aid in studying complex tissue interactions in terms of cell communication, response to matrix geometry, and effect of external chemical stimuli. By understanding how physical surface parameters influence cellular adhesion and differentiation, we can more effectively design biomaterial interfaces that can be used in a clinical setting.