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Nanotechnology is being used to mimic structural components of our tissues in synthetic materials intended for various implant applications. Nanomaterials have increased surface area, surface roughness, and energy which optimally interact with proteins that control cell functions to regenerate tissues. Coupled with such unique surface properties that promote cell functions, nanomaterials can now be fabricated to possesses structural properties necessary for supporting physiological loads (as in the case of orthopedic implants) and/or viscoelastic properties (as in the case of vascular grafts). Novel fabrication methods are being used (such as 3D printing) to create hierarchical tissue substitutes which mimic the micron and nano structure of our tissues, especially bone. Recent studies have highlighted that when compared to currently implanted materials, nanomaterials with random and oriented nanofeatures promote optimal initial protein interactions necessary to mediate cell adhesion and subsequent tissue growth. This has been demonstrated for a wide range of implant chemistries (from ceramics to metals to polymers) and for a wide range of tissues (including bone, vascular, cartilage, bladder, and the central and peripheral nervous system). Recent results have even incorporated the use of stem cells with carbon nanotubes to heal stroke damage in rats. Importantly, these results have been seen at the in vitro and in vivo level. Lastly, through the use of existing antimicrobial chemistries, decreased bacteria infection has been observed through the use of nanomaterials. Since implant infection is a major cause of biomaterial failure, such promoted functions of cells to regenerate tissues coupled with decreased bacteria infection highlights a promising future for nanomaterials in tissue engineering applications. This talk will cover some of the more significant advancements in creating better materials through nanotechnology efforts for controlling cell functions.