Manipulating Cells with Materials

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The West Lab has worked extensively in the development of surfaces and 3D scaffold materials that provide a high degree of control over cell adhesion and signaling events. These materials support very low levels of protein adsorption, and thus cell-material interactions are restricted to those intentionally engineered into the material design. Hydrogel scaffold materials have also been developed that are degraded in response to cellular proteolytic activity. This allows materials to degrade in response to cell activities such as migration rather than continuous hydrolysis as is seen in common polyesters. We have developed patterning technologies in both 2D and 3D to allow spatial control over cell-material interactions. Image-guided laser scanning lithography has allowed us to recapitulate cellular focal adhesion complexes with nanoscale resolution to control and manipulate cytoskeletal architecture of cells seeded on these patterned surfaces. We can prepare highly homogeneous cellular arrays using this technology. Two-photon laser scanning lithography allows 3D micropatterning of covalently immobilized peptides and proteins in hydrogels, again with nanoscale resolution, to guide cell migration and network assembly. This technology allows free-form 3D patterning for material fabrication, immobilization of bioactive factors, or manipulation of mechanical properties. Additionally, confocal images from tissues can be used to develop patterning instructions in order to recapitulate complex tissue architectures within scaffold biomaterials.

Jennifer West joined the faculty at Duke in 2012, after having been the department chair and Cameron Professor of Bioengineering Rice University. She became associate dean for PhD education in the Pratt School of Engineering in 2015. Professor West was elected to the National Academy of Engineering in 2016 and to the National Academy of Inventors in 2017.

Professor West’s research focuses on the development of novel biofunctional materials. Part of her program has developed nanoparticle-based approaches to biophotonics therapeutics and diagnostics. An example of this work is the application of near-infrared absorbing nanoparticles for photothermal tumor ablation. In animal studies, this therapeutic strategy has demonstrated very high efficacy with minimal side effects or damage to surrounding normal tissues. In 2000, Professor West founded Nanospectra Biosciences, Inc. to commercialize the nanoparticle-assisted photothermal ablation technology, now called AuroLase. Nanospectra Biosciences, Inc., located in Houston, TX, is the recipient of a NIST ATP Award and a grant from the Texas Emerging Technology Fund. Professor West is a director of the company. The company has built manufacturing facilities, and AuroLase cancer therapy is now in human clinical trials.