Abstract:
Regenerative Medicine has long focused on the replacement of tissues lost to disease. The patient quality of life, scientific challenges, and market cost associated with replacing lost tissues motivates the development of strategies to identify disease at an early stage, prior to tissue function being compromised, such that treatment can be initiated to prevent tissue failure or degeneration. I will discuss our work with applying tissue engineering principles to cancer and autoimmune disease in which tissues are created as surrogates for the native tissue that can report on the health status of the host. In cancer, distant recurrence is often detected once tumor cells affect the function of solid organs, with a high disease burden that can negatively impact effective treatment. We have engineered a synthetic metastatic niche that captures early metastatic breast cancer cells. In autoimmune diseases, the autoreactive T cells can induce tissue destruction that is not detected until function is compromised. An engineered tissue was able to capture the dysregulation of the immune system that precedes tissue destruction. For both applications, the engineered tissue is grown subcutaneously and can be readily accessed. The gene expression profiles of the engineered tissue reflected disease initiation and progression, and the information in the tissue was distinct from what could be determined from a liquid biopsy. The application of a therapy at an early stage of disease detection was able to prevent tissue destruction and improved outcomes in pre-clinical models. Interestingly, the engineered tissue could also be monitored to determine the efficacy of the therapy. Collectively, these engineered tissues provide a surrogate to a solid organ, which are easily accessible and can be monitored for disease initiation or response to therapy to enable longitudinal, individualized monitoring of disease that may have implications for precision medicine.

Bio:
Lonnie Shea is the Chair of the Department of Biomedical Engineering at the University of Michigan (U-M), which is joint between the College of Engineering and the School of Medicine. He received his PhD in chemical engineering and scientific computing from U-M in 1997, working with Professor Jennifer Linderman. He then served as a postdoctoral fellow with then ChE Professor David Mooney in the Department of Biologic and Materials Science at the U-M Dental School. Shea was recruited to Northwestern University’s Department of Chemical and Biological Engineering and was on the faculty from 1999 to 2014. In 2014, Shea was recruited back to the University of Michigan as chair of the Department of Biomedical Engineering, with his recruitment coinciding with the endowment of the chair position by William and Valerie Hall. He is the Steven A. Goldstein Collegiate Professor of Biomedical Engineering and is an internationally recognized researcher at the interface of regenerative medicine, drug and gene delivery, and immune-engineering, whose focus is on preventing tissue degeneration or promoting tissue regeneration. His projects include islet transplantation for diabetes therapies, nerve regeneration for treating paralysis, autoimmune diseases and allogeneic cell transplantation, cancer diagnostics, and ovarian follicle maturation for treating infertility.

Shea has published more than 230 manuscripts, and has numerous inventions to his credit. He is the PI for the Coulter Foundation Translational Research grants committee at the University of Michigan. He served as director of Northwestern’s NIH Biotechnology Training Grant. He has received the Clemson Award from the Society for Biomaterials, is a fellow of the American Institute of Medical and Biological Engineering (AIMBE) and the Biomedical Engineering Society (BMES), a member of the editorial boards for multiple journals such as Molecular Therapy, Biotechnology and Bioengineering, and the Journal of Immunology and Regenerative Medicine.