A layer-by-layer (LbL) technique toward construction of nanostructured nanoparticles provides a unique platform approach for drug delivery and nanomedicine. We have generated LbL outer layers that provide effective stealth properties, with long systemic plasma blood half-lives and higher tumor accumulation over time, and demonstrate efficacy in advanced breast and lung cancer models in which siRNA targets have been delivered with chemotherapy drug in the same nanoparticle system. We are now examining new siRNA and drug combinations in ovarian cancer. By staging release of different drug components via the adaptation of the nanoparticle structure, we can achieve highly synergistic release behavior in these systems. We have found that certain LbL nanoparticle formulations traffic differently in cells based on the negatively charged polypeptide, and are exploring ways to utilize these differences in affinity for more selective tumor cell binding and deliver within cells. Ongoing work includes addressing barriers to transport of these nanoparticles relevant to tumor or other tissue penetration, and will be discussed, including new work involving the understanding of these trafficking patterns and a means to leverage them toward the delivery of cytokines for activation of the immune system against cancer. Finally, we have also begun investigating how these polymeric colloidal systems undergo release mechanisms when in the tumor microenvironment.
Bio: Professor Paula T. Hammond is the David H. Koch Chair Professor of Engineering at the Massachusetts Institute of Technology, Head of the Department of Chemical Engineering and a member of MIT’s Koch Institute for Integrative Cancer Research. Her research in nanomedicine encompasses the development of new biomaterials to enable drug delivery from surfaces with spatio-temporal control. She investigates novel responsive polymer architectures for targeted nanoparticle drug and gene delivery, and is known for her work on nanoparticles to target cancer, and thin film coatings to release factors that regenerate bone and assist in wound healing. More recently, she has worked on nanomaterials systems to treat osteoarthritis and staged release systems for the delivery of vaccines. Professor Paula Hammond was elected into the National Academy of Science in 2019, the National Academy of Engineering in 2017, the National Academy of Medicine in 2016, and the 2013 Class of the American Academy of Arts and Sciences. She has also recently received the American Institute of Chemical Engineers (AIChE) Margaret H. Rousseau Pioneer Award for Lifetime Achievement by a Woman Chemical Engineer in 2019 and gave the Materials Research Society (MRS) David Turnbull Lectureship, 2019. Professor Hammond has published over 330 papers, and over 20 patent applications. She is the co-founder and member of the Scientific Advisory Board of LayerBio, Inc., a member of the Scientific Advisory Board of Moderna Therapeutics and a member of the Board of Alector, Inc.