Intersection of Engineering and Biology across the Scales: Opportunities for Personalized Diagnostics and Printing Cellular Machines

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Abstract:

Integration of biology, medicine, and engineering and especially fabrication methods at the micro and nano scale offers tremendous opportunities for solving important problems in biology and medicine and to enable a wide range of applications in diagnostics, therapeutics, and tissue engineering. Specifically, microfluidics and Lab-on-Chip can realize applications in detection of disease markers, counting of specific cells from whole blood, and for identification of nucleic acids using sensitive and specific, point-of-care and personalized technologies. The implication of these technologies for advancing personalized medicine for diagnosis of infection and stratification of sepsis would be discussed. Moving up the scale from nanotechnology and microfluidics, 3D bio-fabrication methods for biohybrid polymer devices can also be used to develop instrumented tissues for drug screening and biohybrid robotics. As these cellular machines increase in capabilities, exhibit emergent behavior, and potentially reveal the ability for self-assembly and self-repair, important questions can also arise about the ethical implications for this direction of research, which are very important to consider and address. These cellular systems present many opportunities in the next decade and beyond with potential applications in drug delivery, power generation, and other biomimetic systems.