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Rapid DNA Amplification: Recent Approaches to Accelerating Nucleic Acid Diagnostic Methods

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Extended Abstract

The covid19 pandemic has made evident the essential role that diagnostic tests based on the polymerase chain reaction (PCR) can play in infection control. Based on the selective amplification of nucleic acids, PCR is able to detect the presence of a very low concentration of specific DNA or RNA molecules (down to single molecules in some cases). Since its invention 40 years ago, PCR has become the standard diagnostic procedure for a wide variety of infections, and also finds application in many other fields such as agriculture, forensic science, forestry and environmental health. The PCR amplification process requires that the sample under test be thermocycled between the DNA annealing temperature (around 55°C) and melting temperature (around 95°C) 30-40 times. Conventional PCR thermocyclers make use of thermoelectric heaters and coolers to accomplish this, and as a result are often bulky and have a high power consumption. Typically they require at least 30 minutes (and up to one hour) to deliver a result. Recently there have been a number of innovations in methods to reduce the time to result, and also to decrease the bulk, cost and power requirements of PCR thermocyclers. Often the objective of these innovations is to transform PCR into a point-of-care (POC) diagnostic tool. This talk will describe some of these approaches, with a particular focus on thermocycling using laser heating of plasmonic nanoparticles or films, but also considering other aspects including microfluidics and biological factors. It will also highlight some of the significant challenges that remain in translating PCR to the POC arena.