PCR biocompatibility of Lab-on-a-chip and MEMS materials

DNA amplification using the polymerase chain reaction (PCR) is an important tool in biotechnology, pathogen surveillance in food, medical and forensic science etc. The PCR technique is now an important part of the research in and development of miniaturized biochemical analysis systems. However, reduced or no DNA amplification at all is an important challenge for microfabricated PCR devices due to a negative interaction between PCR chemicals and the surrounding environment, i.e. the materials encapsulating the PCR mix. Materials of special interest regarding PCR compatibility are silicon, glass and polymers, which are important in the fabrication of microelectromechanical systems (MEMS), micro total analysis systems (mu TAS) and lab-on-a-chip (LOC) systems. The PCR inhibition effect is a particularly important phenomenon in microsystems due to an increased surface-to-volume ratio which enhances the possibility of interaction between the surfaces and ingredients in the PCR mixture. By proper surface treatment the PCR reaction can be facilitated and in this paper we present a systematic and quantitative study of the impact on the PCR compatibility of a chemical and a biological surface treatment. The chemical treatments are based on the silanizing agent dichlorodimethylsilane \([\text{CH}_3\text{SiCl}_2]\), while the biological treatment is based on the protein bovine serum albumin (BSA). We present a simple model system for the investigation of the PCR compatibility of three widely used materials in microfabrication, namely silicon, glass and SU-8. The impact on PCR performance, measured by means of PCR efficiency, of untreated as well as chemically and biologically treated materials is studied. We show a convenient method of assessing the PCR compatibility of silicon, glass and SU-8 with a degree of information not presented before.

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