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PDMS MICROFLUIDICS STRUCTURES IRREVERSIBLY BONDED TO MODIFIED POLYMER FILMS BY SILANOL SURFACE ACTIVATION

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Within micro-electromechanical systems (MEMS), the miniaturisation of fluidic devices, has opened an important field for development in industry [1]. Microdevices for microfluidic channels were developed upon substrates such as glass, silicon and quartz by techniques such as wet chemical etching, photolithography and by cover bonding processes. The fabrication of these microfluidic devices increased costs and were limited within fabrication, packaging and testing due to the materials and techniques that were utilised. However, in recent years organic polymers such as poly(dimethylsiloxane) (PDMS) and poly(methylmethacrylate) (PMMA) have been employed to create these microfluidic devices due to their low costs and biocompatibility [2].

Here, we describe techniques for the production of PDMS replica microfluidic mixing channels, manufactured from PDMS, that have been chemically bonded to functionalised substrates that consist of glass, poly(ethylene naphthalenedicarboxylate) (PEN), poly(ethylene terephthalate) (PET) and polyimide (PI). These polymers have been activated to induce silanol (Si-OH) bonds on the top surface, for the encapsulation within microfluidic produced PDMS replicas. In relation to these micro-mixers, we also address some of the technical problems that are involved within micro-filter and micro-mixer fabrication before assembly for microfluidic devices.

Analysis on the surface of the polymer substrates by contact angle measurement indicate that the surfaces have been chemically altered to a more hydrophilic nature in comparison with the unmodified hydrophobic polymer surfaces. While characterisation techniques of FTIR and ToF-SIMS, have established the functional groups that have been attached to the surfaces of these polymer films.

Results have illustrated that PEN, PET and PI can be bonded to PDMS microfluidic structures with strong affinity and that no leakage is apparent when solutions are injected into the injection ports. With the injection of two types of dyes, we can visibly see mixing occurring within the microfluidic mixing channels. Also by varying the solvent with the silane based compound, we can reduce incubation time and bonding time of the modified polymer substrates to approximately 20 minutes of surface activation, while bonding is irreversible after conformal contact has been made.

Within similar fabrication protocols of the micromixer, microfluidic filtration pillars have also been produced onto PDMS, though some technical problems arise due to the collapse of these pillar-based structures. Aspect ratios of these pillars and spacing can cause problems that are required to be resolved.

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