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Surface wettability studies in PDMS and its correlation to behavior of fluid flows

PDMS (Poly dimethyl Siloxane) has promising applications in the development of microfluidic platforms for lab on chip type sensing of biological processes like proteome/ genome analysis, pathogen detection, cell and tissue based biosensing etc. Fabrication of such platforms, normally involve standardized soft lithography, replica molding and good wafer level bonding processes by surface energy reduction techniques like exposure to oxygen plasma. Although earlier studies primarily indicate the formation of surface (silanol) polar bonds as a primary reason of change in surface energy and a slow retrieval of the hydrophobic properties with post exposure time yet significant work has not been done towards the behavior of the surfaces to flow of fluids resulting from this gradual recovery of surface energy. This is of course an important area as it provides a lead to the microchip designers about designing the microchannel sizes and a variety of platform structures. The current study involves a novel means of studying the changes of surface energy with changes in fluid flow behavior. The surface energy is characterized as a change in contact angle of DI water (Millipore resistivity 17.8 Mohm-cm) with an in-house developed contact angle measurement system using sessile drop method. An activated slab of PDMS with a drop on its surface is kept in a tilting plane and the angle of inclination when drop starts rolling is measured as an indication of surface flow behavior. Slabs exposed to atmosphere for various times after oxygen plasma activation are characterized in this way and show a perfect simile with expected behavior.