Characterization of Polydimethylsiloxane (PDMS) for BioMEMS Application

Jyoti Wala, Santanu Dhara, and Soumen Das

***Abstract*— In recent time polydimethylsilixane (PDMS), an attractive choice for realization of various devices are explored for biomedical applications. However, its properties vary with its composition. Thus variations of morphological and mechanical properties with the PDMS composition have been studied in this work.**

I. Introduction

Recent advancement of microelectromechanical systems (MEMS) technology is presuming good opportunity in field of robotics, flexible electronics, tissue engineering, biomedical and health care applications. Applications of various novel devices is limited by the conventional silicon based microfabrication process due to high cost, non-biocompatibility, and restriction of micropatterning over planar rigid surface. However, in recent times a low cost, biocompatible, flexible polymer, namely polydimethylsiloxane (PDMS) is attractive alternative to silicon to realize MEMS devices satisfying the above requirements. PDMS is widely used to realize Bio MEMS devices like micro surgical tools, catheter mounted flow, pressure, stress sensors and cell culture for studying cellular mechanics, biocompatibility, etc [1]. Present study investigates suitability of various PDMS formulations for mechano-biological characterization of cells [2].

II. Materials And Methods

PDMS substrates were prepared by varying the base (pre-polymer) and curing agent (cross-linker) ratios (w/w) in 5:1, 10:1, 15:1 and 20:1. Surface modification of all the PDMS films were also performed using oxygen plasma to render the surface hydrophilic. The structural and mechanical properties of different PDMS substrates were characterized using (a) surface roughness measurement; (b) contact angle measurement; (c) elastic modulus testing of PDMS films; (d) ATR- FTIR (Attenuated Total Reflectance Fourier Transform Infrared spectroscopy) analysis.

III. Results And Conclusion

Fig.1 shows the variation of roughness, thickness, contact angle and Young's modulus with different composition of PDMS. Although the roughness, thickness and contact angle increases and Young's modulus decreases with the decrease of PDMS cross linking agent. PDMS film thickness and roughness depends on amount of cross-linker agent and speed of the spin coater. Contact angle measurements showed minimum contact angle of 97.83 for pristine PDMS 5:1 and a maximum of 102.545 for pristine PDMS 20:1. Upon treatment with oxygen plasma, surface energy of the PDMS samples increased significantly resulting in a very low contact angle of a minimum of about 12.2 for PDMS 10:1. FTIR results also showed significant decrease in -CH3 groups and increases in -OH groups in plasma treated samples as compared to pristine PDMS. Characterization of PDMS studies demonstrate that all PDMS composition support cell adhesion, proliferation and differentiation for characterization of biological cells.

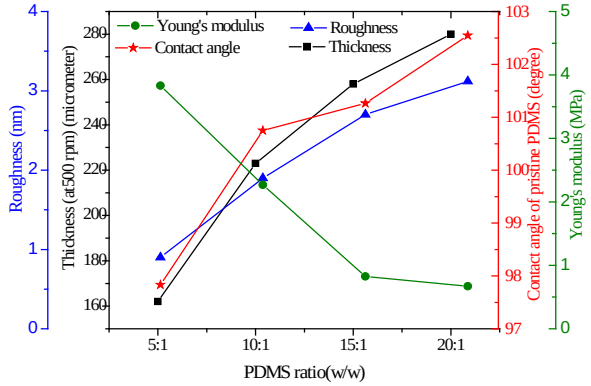

Fig.1 Variation of roughness, thickness, contact angle of pristine PDMS and Young's modulus at different PDMS composition.

Jyoti Wala is with School of Medical Science and Technology, Indian Institute of Technology, Kharagpur-721302, and India (e-mail: jyotiwala@smst.iitkgp.ernet.in).

Soumen Das is with School of Medical Science and Technology, Indian Institute of Technology, Kharagpur-721302, and India (e-mail: sou@smst.iitkgp.ernet.in).

Santanu Dhara is with School of Medical Science and Technology, Indian Institute of Technology, Kharagpur-721302, and India (e-mail: sdhara@smst.iitkgp.ernet.in).

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