The mechanisms of life and their effects to diseases form the basis of biological researches. Due to the dynamic nature of the biological organizations, monitoring of living cells and effects of drugs and chemicals on mammalian cells has very essential importance. In recent years, lab-on-a chip systems have been introduced to detect for cellular organizations quickly and accurately [1]. The aim of this study is designing biofunctional conductive electrode surfaces which will allow long-term cultivation of mammalian cells for lab-on-a chip systems. However, most of the electrodes (gold, platinum, etc.) are not transparent and thus, not suitable for many light microscopy techniques. ITO-glass surface is most advantageous for light microscopy techniques due to its transparent nature; it is also conductive and can be used for electrochemistry.

Here we showed that 4-(2,5-di(thiophen-2-yl)-1H-pyrol-1-l)benzene meta-amine (RMF) monomer can be electropolimerized on ITO electrode surfaces without effect on the surface transparency. We also modified surfaces with RGD peptide to investigate cell adhesion and proliferation. Morphology of the surfaces was analyzed by scanning electron microscopy (SEM) and atomic force microscopy (AFM). Biocompatibility was determined by in vitro tests, the African green monkey kidney cell line (Vero), human keratinocyte cell line (HaCaT) and human neuroblastoma cell line (SH-SY5Y) were cultivated on the biofunctionalized electrode surfaces. Their adhesion, proliferation, spreading and homogeneous distribution on polymers was monitored by fluorescence microscopy. Our results showed that RGD modified electroactive surfaces showed better cell adhesion than non-modified electrode surfaces and conventional polystyrene surfaces. We were able to conduct cell imaging studies up to 72 h on these surfaces with comparing all of the cell lines. We also determined that polymer thickness effects the cell adhesion. The polymers were deposited on the ITO working electrode with scans of 5, 10 and 25 cycles which correspond to 16±2.14, 26±5.14, 31±0.69 nm respectively. The 10 cycle polymer deposited surfaces were the best effective substrates for cell adhesion.

In conclusion, we determined optimum conditions for bio-electronic platforms. Proposed electrode was successfully used for monitoring cell adhesion and viability via microscopic techniques. In future studies, we plan to test cell adhesion and proliferation on this bio modified surfaces by using holographic microscopy in a label-free manner.

References

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Fig. 1: Schematic representation of electrode preparation for cellular imaging platform.