

Metallization Technologies and Strategies for Plastic Based Biochips, Sensors and Actuators for Healthcare and Medical Applications

Yosi Shacham-Diamand, Slava Krylov, Gil Rosenman, Tsvi Shmilovich, Rakefet Ofek Almog, Nicolai Fishelson and Yelen Sverdlov.

Faculty of Engineering, Tel Aviv University, Tel Aviv 69978, Israel
Email: yosish@eng.tau.ac.il

In this paper we present an overview of polymeric based Micro Technology Systems (MST) for healthcare and medical applications. Miniaturized components using flexible materials can bend, stretch and even change their shape. We describe various applications that use that property of flexibility. First we describe a family of micro and nano electrodes for nerve signal sensing, either from the peripheral nerve system or from the cerebellum. Those devices are made on thin polyimide substrates using either gold/Titanium or poly-pyrrole as the conductors and the sensing elements. In some cases we modify the sensing area using TiN or platinum black. Next we describe a novel concept where the flexible materials are actually part of the actuator and can move on demand. It is used to build an extended micro arm, few mm long that can assist during operations where there are access limitations to normal human hands and fingers. In this work we review conventional plastic MST processing. Next we present new methods enhancing conductor/insulators substrate. We discuss various surface treatments of common polymers that are used in micro-machining: polyimide, SU-8 and Poly Di Methyl-siloxane (PDMS). We discuss the effect of UV irradiation, plasma treatment, functionalization using self assembled monolayer (SAM) and electron-beam irradiation. All methods proved to improve metal/polymer adhesion. Following the process descriptions we present basic device modeling, taking advantage of using flexible substrate. It demonstrates the advantage of using soft materials which can be integrated with common sensors and yet allow 3-dimensional motion of the devices.