Conformable Deposition of Biocompatible Parylene-C Coatings for High Aspect Ratio, including LIGA, Microstructures

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Abstract

Presently, the research in the area of miniaturized devices drives the interest of developing a functional coating that can be pin hole free and conformably deposited on varying high aspect ratio (HAR) microstructures [1-6]. Research on parylene at CAMD is addressing the issues and requirements of biocompatible and/or surface functional coatings for HAR including multilevel X-ray fabricated microstructures as well as microfluidic chips. Conformal, functional coatings of complex, multi-material chips manufactured by state-of-the-art MEMS techniques will be crucial for future applications demanding low fabrication costs. Parylene, a polymeric coating deposited at room temperature, possesses excellent pin hole free, conformable deposition, mechanical strength, stress-free, chemically inert and barrier properties [7-8]. In the present study Parylene-C deposited on polymeric and metallic substrates was characterized by scanning electron microscopy (SEM) and optical profilometry.

Parylene-C was conformably deposited on various microfluidic structures with aspect ratios ranging from 1 to >10 using a parylene coater (Paratronix, Inc. Model 494). The surface morphology, conformability and the pin-hole free deposition of the parylene coatings was qualitatively analyzed using an optical microscope (Nikon OptiShot) and SEM (Hitachi S-4500II). Optical profiler (Veeco NT3300) was employed for in-depth quantitative surface morphology and roughness measurements. The results show that by varying deposition process parameters (pressure and temperature), surface roughness can be tailored on rough surfaces it can be lowered from 329 nm to 231 nm and on mirror like surfaces nearly same from 2.14 nm to 1.5 nm.

Additionally, we have employed O_2 plasma to functionalize the surface of parylene by changing its nearly hydrophobic property (89° contact angle) [6, 9] to hydrophilic (28° contact angle). Contact angles were measured using a VCA Optima Surface Analysis System and 2 µL static droplets of de-ionized water.

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