From Conductive Wood Fibers to Conductive Paper – Layer-by-layer Nanoassembly

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The layer-by-layer self-assembly of poly(3,4-ethylenedioxythiophene) poly(styrenesulfonate) (PEDOT-PSS) on lignocellulose pulp fibers to make conducting paper is reported. The surface of pulp fiber was observed to be negatively charged, therefore positively charged poly(allylamine) hydrochloride was alternated with PEDOT-PSS for layer-by-layer assembly. The physical characterization of the fiber before measuring conductivity was done using roughness step tester (RST) and surface profilometer (TENCOR). The thickness of the coated film was estimated using quartz crystal micro-balance. Current – Voltage characterization was done using Keithley measurement system after each self-assembly of PEDOT-PSS to study the electrical properties of the film. It was observed that the conductivity of the fiber increased with increasing layers of PEDOT-PSS. The measured conductivities ranged from (1 to 5)10^{-3} S/cm for unbeaten fibers and from 1 to 10 S/cm for beaten fibers. In this work we are developing scale integration from nano, to micro and macro (nanocoating-microfibers-macropaper). The results obtained show great promises for the development of smart paper technology and its contribution to the economic development of Louisiana and the nation.

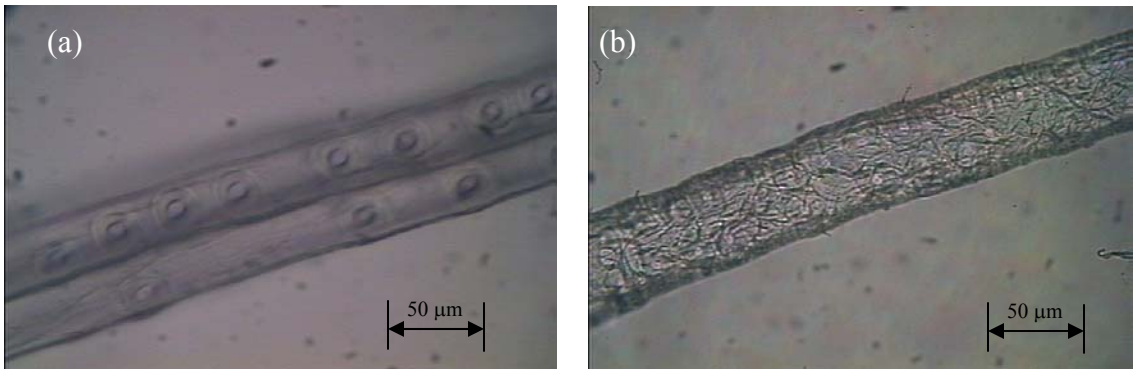

Figure 1: Optical image of the pulp fiber taken using Olympus microscope at 50X zoom. (a) Unbeaten fiber having smooth surface. (b) Beaten fiber having rough hairy surface.

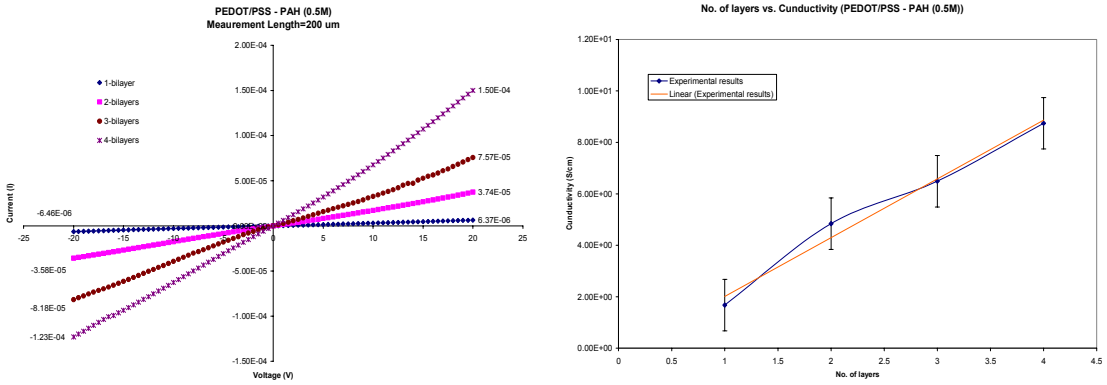

Figure 2: I-V Characteristics & Conductivity of beaten pulp fiber coated with PEDOT-PSS & 0.5M PAH using layer-by-layer assembly.