Supporting Online Information for:

Scalable, Template-Free Synthesis of Conducting Polymer Microtubes

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Table S1 shows the stainless steel substrates specifications: opening size, wire diameter, specific surface area and open area. Specific surface area is the ratio of actual surface area to planar (substrate) surface area. Open area is calculated considering a planar substrate and is the ratio of the planar area with no wires to the planar substrate area.

Table S1: Stainless steel mesh substrates specifications

Mesh	Opening Size [mm]	Wire Diameter [mm]	Sp. Surface Area	Open Area [%]
M40	0.38	0.25	2.5	36
M60	0.23	0.19	2.9	29
M100	0.15	0.11	2.8	36
M200	0.074	0.053	2.6	34
M250	0.061	0.041	2.5	36
M325	0.043	0.036	2.9	31
M400	0.038	0.025	2.5	36

Figure S1 presents the electrochemical characteristics and comparison between the microtubes deposited at different currents densities. Figure S1a shows the time evolution in potential during electrode synthesis profile. Each electrode is deposited for the same total charge on a 1 cm^2 substrate (Q [mC] = j [mA cm^{-2}] * t [s]). Figure S1b shows the cyclic voltammetry plots indicating no significate difference between the capacitance vs potential plots, although the deposition at 10mA does present slight higher capacitance. Figure S1c EIS characterization of the different films are presented, the series resistance of the films increases as the current density increase. The low frequency ends of the kinetic control part of the Nyquist plot are 39.81, 79.43, 31.62, 25,12 Hz for 10, 12, 14, 16 mA respectively.

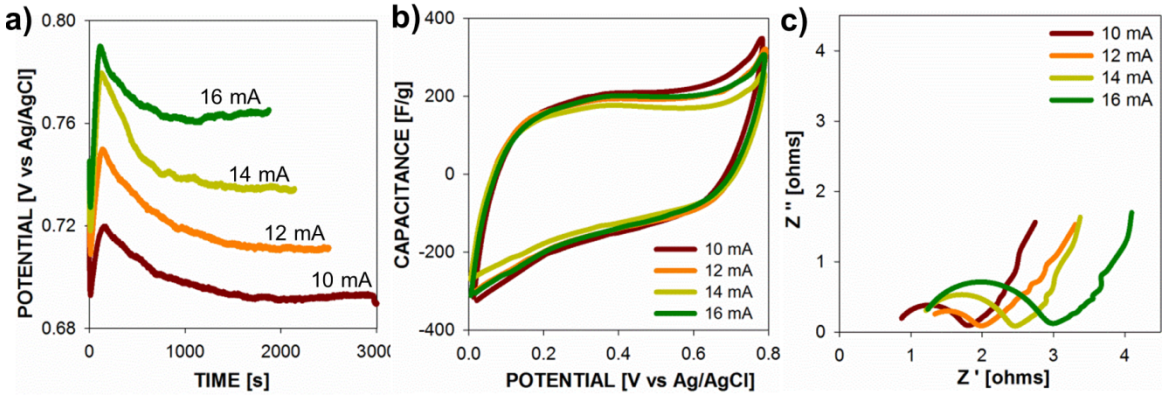

Figure S1. Electrochemical properties of polypyrrole microtubes deposited by chronopotentiometry on M200 for 30 C cm^{-2} at different current densities (10, 12, 14, 16 mA cm^{-2}). (a) Deposition profiles, (b) Change in specific capacitances at 10 mV s^{-1}, (c) Nyquist Plot.

The table S2 shows the properties of polypyrrole microtubes deposited with increasing current where it is observed that the thickness of the film increases with the decrease in current. In general the properties of the microtubes are very similar one to the other as the current increases. Other experiments showed that by increasing the concentration of the monomer from 0.09M to 0.2M, thicker meshes can be obtained.

*Table S2: Properties of polypyrrole microtubes deposited with increasing current**

Sample	**Film Thickness [µm]**	**Height [µm]**	**Top diameter [µm]**	**Middle diameter [µm]**	**Bottom diameter [µm]**	**Ratio [D_T to D_M]**
M200 12mA	14	800	280	290	230	1.6
M200 14mA	12	840	240	230	180	1.7
M200 16mA	11	910	260	260	220	1.4

*Deposition conditions 30C cm^{-2}

Microtubes were also observed when deposited with a ramp chronoamperometry which implies the increase of the current every certain amount of time (0.025mA every13s specifically). Smaller microtubes and smoother surface were observed with the presence of poly(4-styrene sulfonic) acid as dopant; the smoothness of the surface is due to the fact that the polymer creates the disruption of the molecular packing between the polypyrrole molecules, preventing the formation of the typical cauliflower structure of polypyrrole (figure S2).

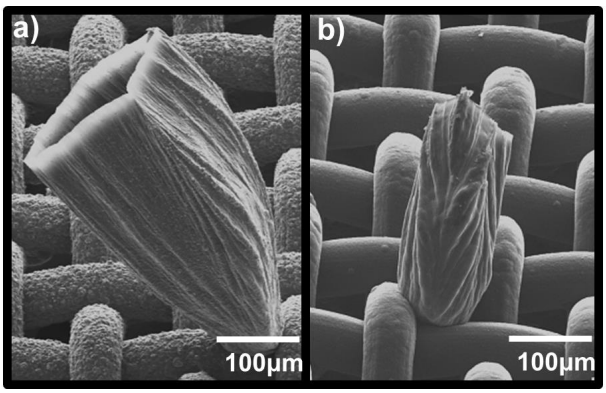

Figure S2. Polypyrrole microtubes deposited with galvanodynamic deposition from 10 to 12 mA cm^{-2} for 13.3 C cm^{-2} with different dopants. (a) 0.5M H_2SO_4, (b) 3.3 wt. % PSSA.

The figure S3 shows the SEM image of one of the samples deposited using the so-called bubble method from the literature. It is observed that ball-like structures are obtain, however this is not the same kind of structures obtained with the method presented in this work.

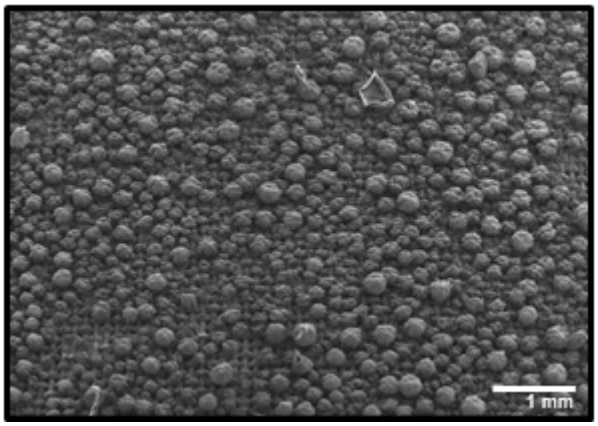

Figure S3. Bubble method, M200 with 1 cyclic voltammetry cycle from -0.3V to -0.8 V at 0.1V s^{-1}, followed by chronopontentiometry at 16mA for 60C.