Supplementary Material

Conductive Cellulose Nanocrystals with High Cycling Stability for Supercapacitor Applications

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Thermal gravimetric analyses (TGA) were conducted to qualitatively estimate the mass loading of PPy coating with different degree of CNC modification with PVP. Due to the higher thermal stability of PPy shell, the higher PPy loading should demonstrate milder decomposition closer to the bulk PPy sample synthesized under the same condition only in the absence of CNC nanoparticles or PVP. Compared with PVP/CNC ratio 100 and 10, the higher PVP addition resulting in the lower PPy loading (35% mass retention for PPy/PVP100/CNC versus 48% PPy/PVP10/CNC at 400 degrees). When no PVP is added to modify CNC, the PPy loading is comparably low as PPy/PVP100/CNC sample demonstrating incomplete PPy coating or a low PPy polymerization efficiency.

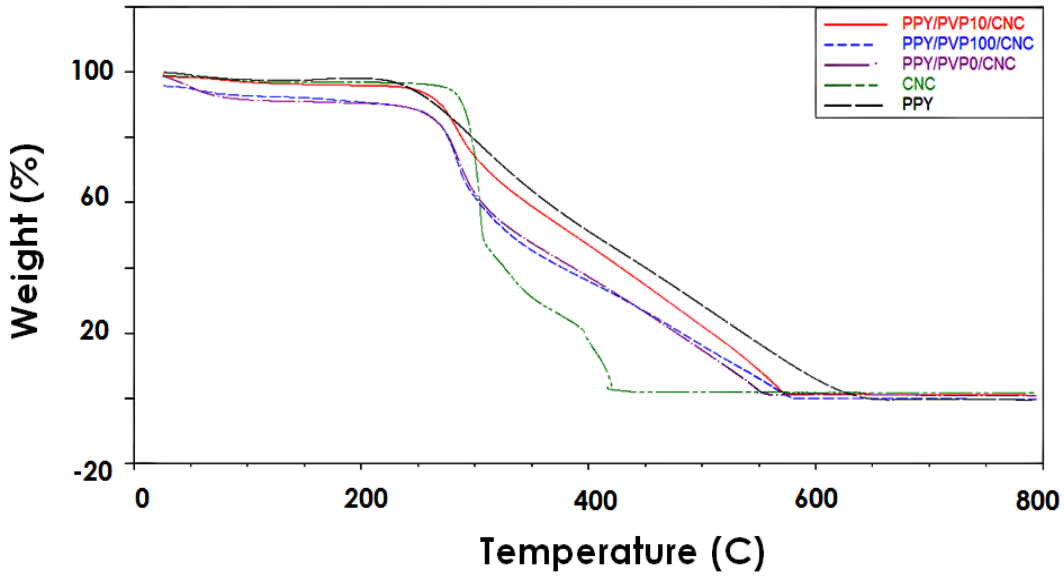

Figure S1. TGA curve for Pristine CNC, PPy, PPy/PVP100/CNC, PPy/PVP10/CNC, PPy/PVP0/CNC. All samples were placed in an inert ceramic crucible and heated from 25 to 800 °C at a heating rate of 10°C/min in 20 mL/min in air atmosphere.

The UV-Vis spectra of PVP adsorbed CNC shows the characterization peak of PVP at 220 nm indicating the successful attachment of PVP to CNC sample prior to the synthesis. The PPy coated samples at different CNC modification extent all show a peak at 420 and a broader peak around 900 nm, attributing to the characterization peaks of polypyrrole. Due to the coating of PPy, the buried PVP peak has shifted to a lower wavenumber from the incomplete peak shown for sample PPy/PVP100/CNC.

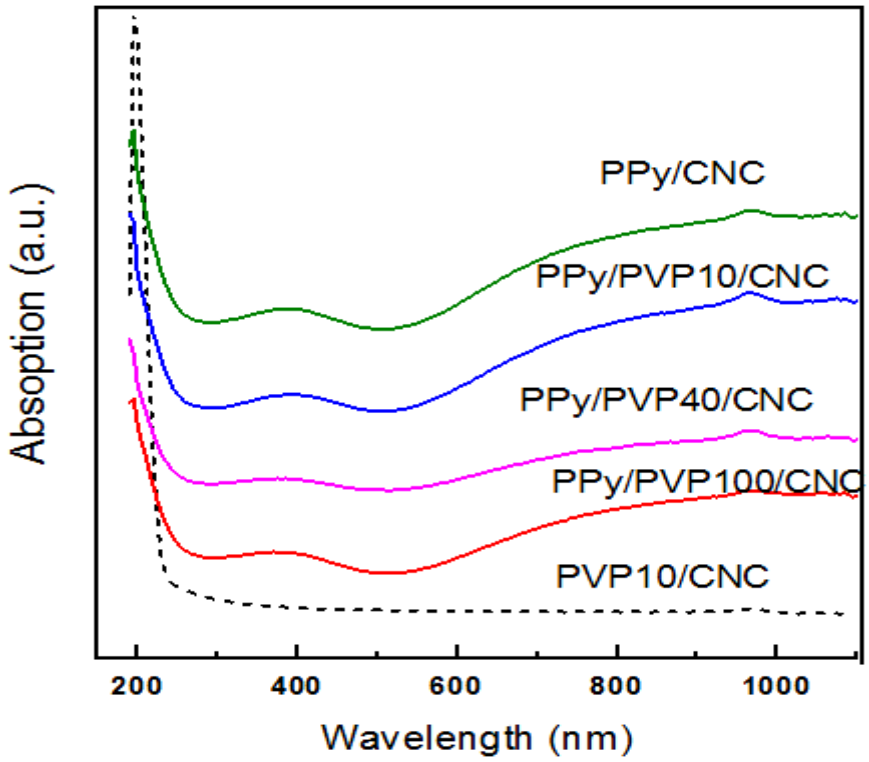

Figure S2 UV-Vis spectra of PVP adsorbed CNC, PPy coated CNC samples of different PVP modification extent.

The PPy coating on CNC was also verified by FT-IR spectroscopy. The characterization peaks indicating the presence of PPy, PVP, and CNC are summarized in the table below. The most important phenomenon is that several strong peaks in PVP or CNC is significantly suppressed after the PPy coating: e.g. C-H stretching peak for PVP at 2956 cm^{-1} and C-O stretching of CNC at 2900 cm^{-1}, which indicates that the two materials are well embedded in the PPy shell.