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Synthesis and characterization of novel polypyrrole hybrid nanotubules incorporated with polyaniline spots

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Abstract

This study reports the preparation and characterization of new polypyrrole-polyaniline (PPy-PANi) hy-brid nanostructures composed of PPy nanotubules and PANi spots. The chemical incorporation of some PANi spots onto a PPy nano-tubule was carried out successfully using a successive synthetic process within porous polycarbonate Particle Track-etched Mem-branes. Hybrid PPy nanotubules with PANi spots were formed be-cause PANi was synthesized within the void space-walls of the PPy surface. These hybrid PPy-PANi nanostructures exhibited unique phase-separated morphological properties due to the PANi spots distributed randomly in the PPy matrix. The synergistic and shape effects of the PPy-PANi hybrid nanotubules were exploited in terms of the conductivity and energy storage. The electrical con-ductivity and capacitance of the PPy-PANi hybrid tubules were en-hanced sufficiently compared to the analogous PPy nanotubules.

Objective

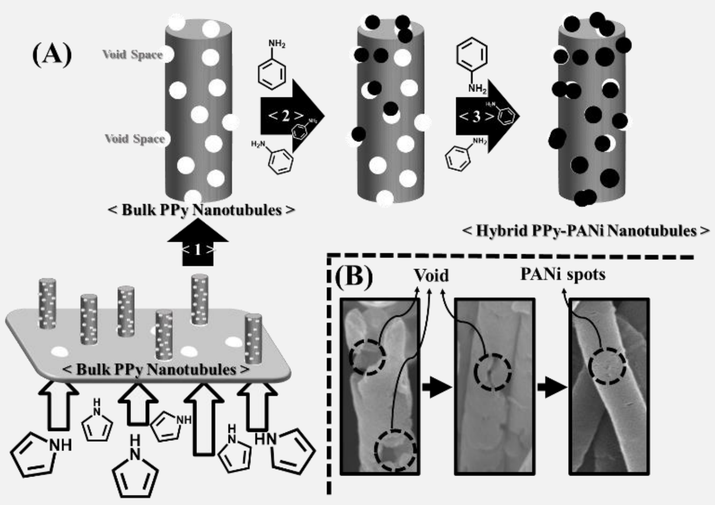
1. Aqueous chemical oxidation polymerization of PPy nanotubules covered with PANi spots using polycarbonate microporous Particle Track-etched Membranes.

2. Advantage of PPy-PANi hybrid nanotubules used in respect with its electrical properties, comparing to bulk PPy and PANi nanotubuels.

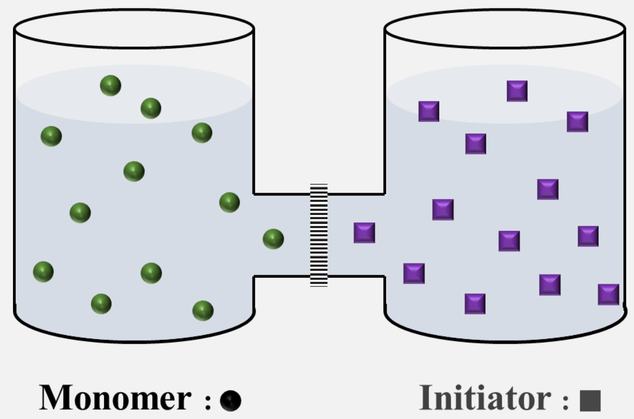
Preparation of PPy hybrid nanotubules with PANi spots

- Enhanced conductivities of PPy-PANi hybrid nanotubules as a function of reaction time
- Enhanced capacitive performance of the PPy-PANi hybrid nanotubules compared to the bulk PPy nanotubules

Experimental



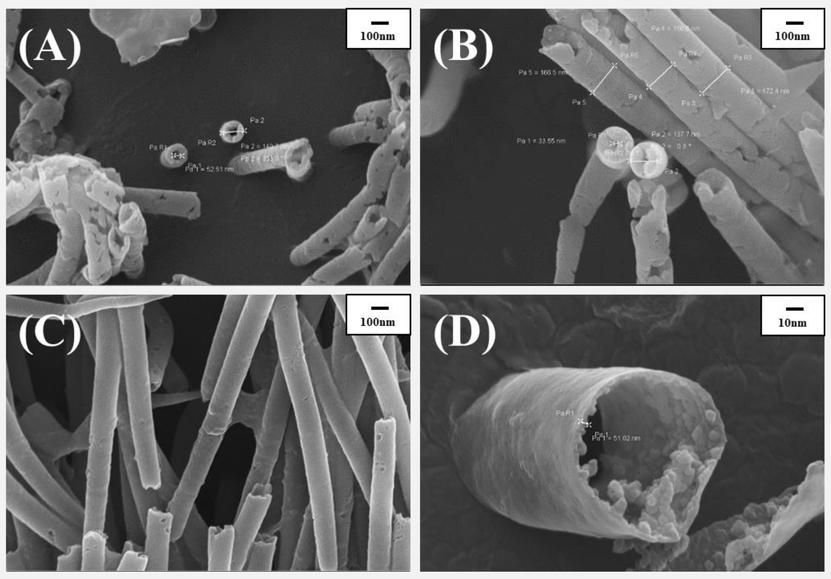
Scheme 1. (A) Schematic illustration to create a novel hybrid nano-tubule incorporated main PPy frame with PANi spots and (B) the successive filling mechanism inside void spaces of PPy nanotubules by the successive synthesis of PANi spots.



Scheme 2. The two compartment cell used to perform chemical oxidative polymerization of PPy nanotubules with PANi spots.

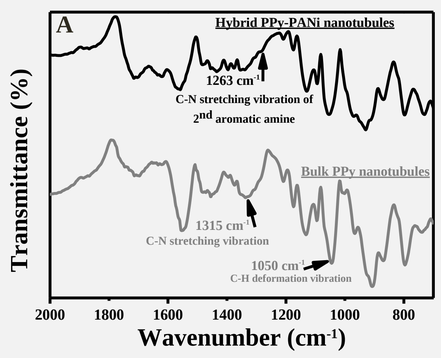
Results

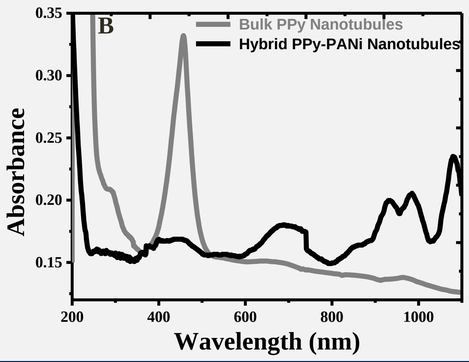
SEM



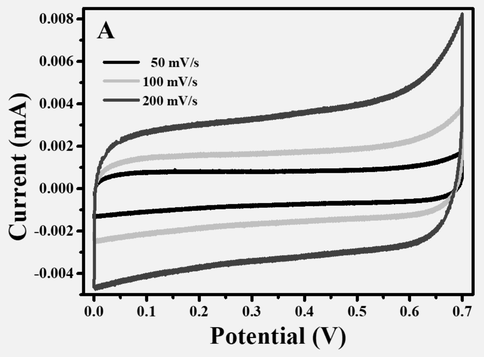
<SEM images of (A) initial and (B) intermediate void spaces of PPy, (C) the hybridization of PPy nanotubules by filling with PANi spots and (D) the cross section of PPy-PANi hybrid nanotubules>

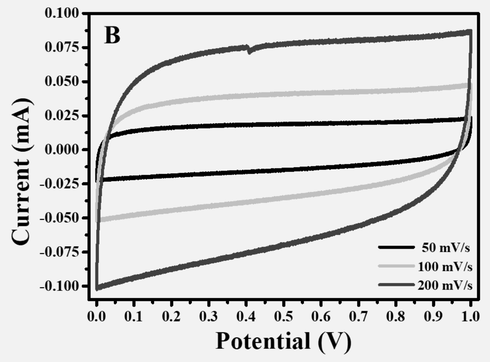
Optical property





Electrical and thermal property





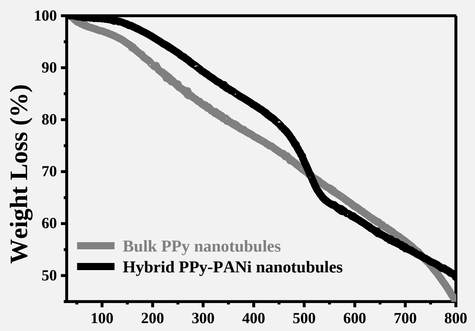


Table 1. Electrical conductivities of bulk PPy and hybrid PPy-PANi nanotubules.

Sample	Bulk PPy	Hybrid PPy-PANi
Electrical conductivity (S/cm)	$1.26*10^{-3}$	$5.03*10^{-3}$

Conclusion

- The facile generation of the unique PPy-PANi hybrid nanotubules by incorporating PANi spots into the void spaces of PPy nanotubules
- The provision of the successive synthesis process of individual π-conjugated polymer in the same PC-m-PTM
- The enhancement capacitive performance of the PPy-PANi hybrid nanotubules compared to the PPy nanotubules

Acknowledgement

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