Pd nanoparticals dispersed on low-defect carbon nanotube: for use as high-performance anode catalyst of DFAFC

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Well-dispersed Pd nanoparticles supported on low-defect carbon nanotube (Pd-LCNT) are successfully prepared by a soft chemical method. Our approach can efficiently avoid damaging the CNT framework in the composite because it does not require cumbersome oxidation of CNT in advance and needs no subsequent reduction of the low-defect carbon nanotube due to the lower oxidation degree.

Morphology observations show that the Pd nanoparticles with diameters ranging from 3 to 4 nm are evenly deposited on graphene sheets (Fig.1A). While in the case of Pd supported on acid-treated carbon nanotube (Pd-ACNT), it is evident that the particle size distribution is much broader than Pd-LCNT with a significant fraction of Pd particles larger than 10 nm (Fig. 1B). Raman spectroscopic analysis results reveals a lower I_D/I_G intensity in Pd-LCNT's spectrum, which means there is only a very small amount of CNT defects in the Pd-LCNT compared with Pd-ACNT (Fig. 1C). This can be explained by that, the unsaturated C–C bonds (C_π sites) are actually more efficient sites for anchoring the Pd particles and play a critical role in the formation of Pd–C hybrids. Also, the CV test shows the as-prepared hybrid exhibited significant catalytic activity for formic acid oxidation (Fig. 1D).

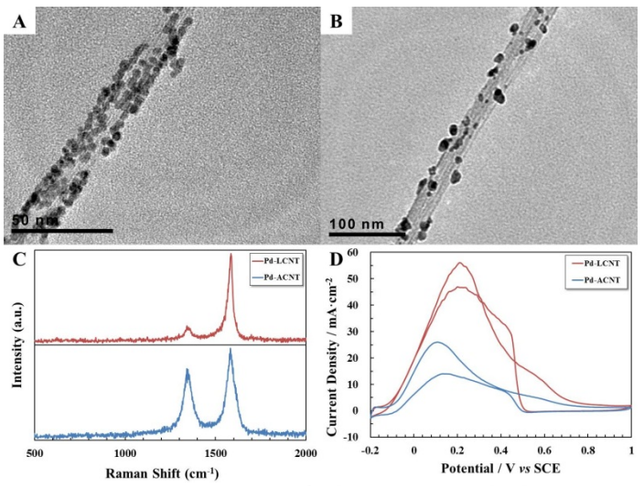

Fig. 1. TEM images of Pd-LCNT (A) and Pd-ACNT (B). Raman spectra of Pd-LCNT and Pd-ACNT (C). (D) CV curves of Pd-LCNT and Pd-ACNT recorded in 0.5M H_2SO_4 and 0.5M HCOOH.