Production of nitrogen-doped multiwall carbon nanotubes using Fe-rich red soil from Sierra de Álvarez, San Luis Potosí, México.

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Due to the excellent electrochemical properties of nitrogen-doped multiwall carbon nanotubes (N- MWCNTs) as electrodes, the use of natural or waste materials as catalysts for producing large amounts of N-MWCNTs is of primary relevant interest to investigate due because this is an issue largely unexplored field. In this work, an Fe-rich red soil from the southeast region of San Luis Potosi (Sierra de Alvarez), Mexico was used as catalyst to fabricate a relatively substantial amount of N-MWCNTs by an aerosol-assisted chemical vapor method. Both the pristine and a ball-milled (1h) Fe- rich red soil samples were used in order to test fabrication efficiencies. Scanning and transmission electron microscopies, X ray diffraction, Raman spectroscopy, X-ray fluorescence and thermogravimetric analysis techniques were used to characterize the catalysts and the N-MWCNTs samples. The efficiency of N-MWCNTs production was 58.37 wt. % and 93.54 wt. % for pristine and ball-milled samples, respectively. The macroscopic aspect of N-MWCNTs was spongy with a crumbing consistency. Catalyst samples were comprised of quartz, kaolinite, and iron and titanium oxides, while N-MWCNTs samples were comprised of graphitic carbon, iron carbide, α-Fe, and silicon oxide. X-ray fluorescence iron concentration in catalyst soil samples accounted for up to 30% iron. Electrochemical tests were carried out to study N-MWCNTs potential application in capacitors.