New method to prepare nanopalladium clusters immobilised on carbon nanotubes, a very efficient catalyst for forming the carbon-carbon bonds and hydrogenation

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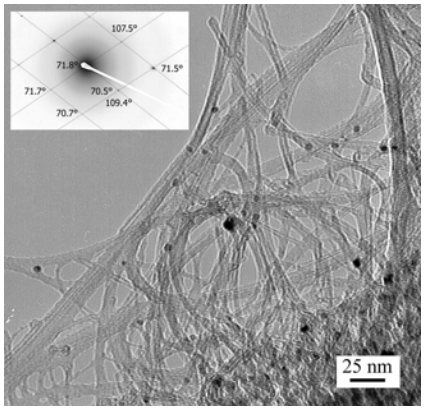
Structural similarity between fullerenes and carbon nanotubes have been used for the preparation of palladium complexes by direct reaction of Pd(0) complex and strained double bonds in CNT: $Pd_2(dba)_3$ + MWNT → [xPd-MWNT], Pd/CNT; dba = (dibenzylideneacetone)

Metal nanoclusters can be seen on the following TEM picture, the average size is around 4.5 nm.



These complexes have been successfully used as catalysts in the hydrogenation of unsaturated hydrocarbons and in reactions of Suzuki, Heck, and Sonogashira wherein the new carbon-carbon bonds are formed [1]. Novel catalysts are recyclable, can work in aqueous media and met all requirements of "green" chemistry because do not contain any ligands. They are much more active in hydrogenation than standard catalysts Pd/C. Examples of reactions catalyzed by Pd/CNT are given below.

$$Y\text{-}\ C_6H_4\text{-}B(OH)_2 + I\text{-}C_6H_4\text{-}X \rightarrow Y\text{-}\ C_6H_4\text{-}\ C_6H_4\text{-}X$$
$$Ar\text{-}{\equiv}\text{-}H + I\text{-}C_6H_4\text{-}X \rightarrow Ar\text{-}{\equiv}\text{-}C_6H_4\text{-}X$$

[1] V.I. Sokolov, N.A. Bumagin, I.V. Anoshkin, E.G. Rakov, M.G. Vinogradov. *Nanotechnologies in Russia* **3**(9-10), 570 (2008).