Colloids and Surfaces A: Physicochem. Eng. Aspects 486 (2015) 185–191

Contents lists available at ScienceDirect

Colloids and Surfaces A: Physicochemical and Engineering Aspects

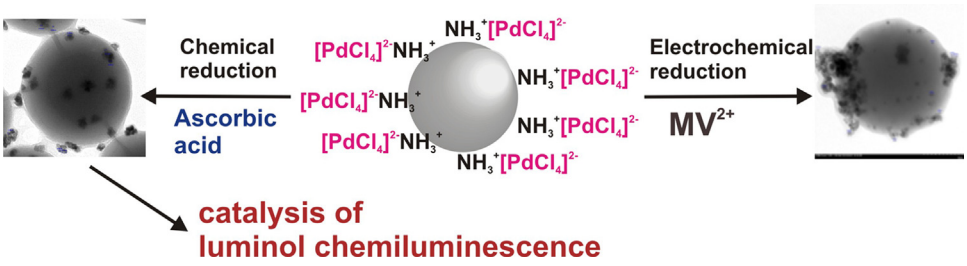
journal homepage: www.elsevier.com/locate/colsurfa

Surface decoration of silica nanoparticles by Pd(0) deposition for catalytic application in aqueous solutions

Svetlana Fedorenko[a,*], Michael Jilkin[b], Natalya Nastapova[a], Vitaliy Yanilkin[a], Olga Bochkova[a], Vladimir Buriliov[b], Irek Nizameev[a], Gulnaz Nasretdinova[a], Marsil Kadirov[a], Asiya Mustafina[a], Yulia Budnikova[a]

[a] A.E Arbuzov Institute of Organic and Physical Chemistry, Kazan Scientific Center, Russian Academy of Sciences, Arbuzov str., 8, 420088 Kazan, Russia
[b] Kazan (Volga region) Federal University, Kremlyovskaya str., 18, 420008 Kazan, Russia

GRAPHICAL ABSTRACT



HIGHLIGHTS

- Synthetic routes of Pd(0) deposition onto silica nanoparticles in water.
- Synthetic conditions for homogeneous Pd(0)/silica aqueous colloids.
- Size of deposited Pd(0) is optimized by synthetic procedure.
- Hybrid Pd(0)/silica nanomaterial catalyze chemiluminescence of luminol.

ARTICLE INFO

Article history:
Received 29 July 2015
Received in revised form 9 September 2015
Accepted 16 September 2015
Available online 21 September 2015

Keywords:
Hybrid nanomaterial
Silica nanoparticles
Palladium
Catalysis
Luminol
Chemiluminescence

ABSTRACT

The work introduces chemical and electrochemical synthetic routes to obtain Pd(0) nanoparticles (PdN deposited onto silica supports in aqueous media. The former route is performed through reduction $Na_2[PdCl_4]$ by ascorbic acid in the presence of amino-modified silica nanoparticles (SiO_2–NH_2). The tim dependent variation of pH and the reductant concentration is the simple synthetic route to get unifo deposition of 215 nm sized silica supports by Pd(0) nanoparticles (3–10 nm). The methylviologe mediated electrochemical synthetic route results in small PdNPs (3–9 nm) located both onto and beyo the silica supports. Thus, the chemical synthetic route provides more homogeneous Pd(0)–SiO_2–N aqueous colloids. The results reveal that attractive interactions of amino/ammonium groups of SiO_2–N with both $[PdCl_4]^{2-}$ and ascorbate-stabilized Pd(0) seeds are the key reasons for the better Pd(deposition onto silica supports. The chemically deposited Pd(0)–SiO_2–NH_2 nanoparticles catalyze chemiluminescence of luminol resulted from the H_2O_2-facilitated oxidation in alkaline aqueous solutio

* Corresponding author.
E-mail addresses: Svetlana.fedorenko@yahoo.com (S. Fedorenko), yalizar@yandex.ru (M. Jilkin), nastapova@iopc.ru (N. Nastapova), yanilkin@iopc.ru (V. Yanilkin), o.d.bochkova@mail.ru (O. Bochkova), ultrav@bk.ru (V. Buriliov), irek.rash@gmail.com (I. Nizameev), nasybullina@iopc.ru (G. Nasretdino kamaka59@gmail.com (M. Kadirov), asiyamust@mail.ru (A. Mustafina), yulia@iopc.ru (Y. Budnikova).

http://dx.doi.org/10.1016/j.colsurfa.2015.09.044
0927-7757/