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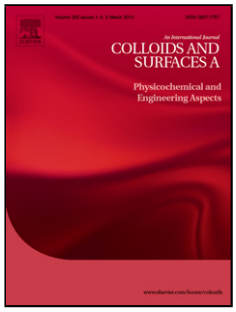

Title: To the nature of the support effect in palladium-catalyzed aqueous-phase hydrogenation of maleic acid

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PII: S0927-7757(16)30989-X
DOI: http://dx.doi.org/doi:10.1016/j.colsurfa.2016.11.037
Reference: COLSUA 21174

To appear in: *Colloids and Surfaces A: Physicochem. Eng. Aspects*

Received date: 15-9-2016
Revised date: 11-11-2016
Accepted date: 14-11-2016

Please cite this article as: M.A.Kulagina, P.A.Simonov, E.Yu.Gerasimov, R.I.Kvon, A.V.Romanenko, V.I.Bukhtiyarov, To the nature of the support effect in palladium-catalyzed aqueous-phase hydrogenation of maleic acid, Colloids and Surfaces A: Physicochemical and Engineering Aspects http://dx.doi.org/10.1016/j.colsurfa.2016.11.037

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ACCEPTED MANUSCRIPT

To the nature of the support effect in palladium-catalyzed aqueous-phase hydrogenation of maleic acid

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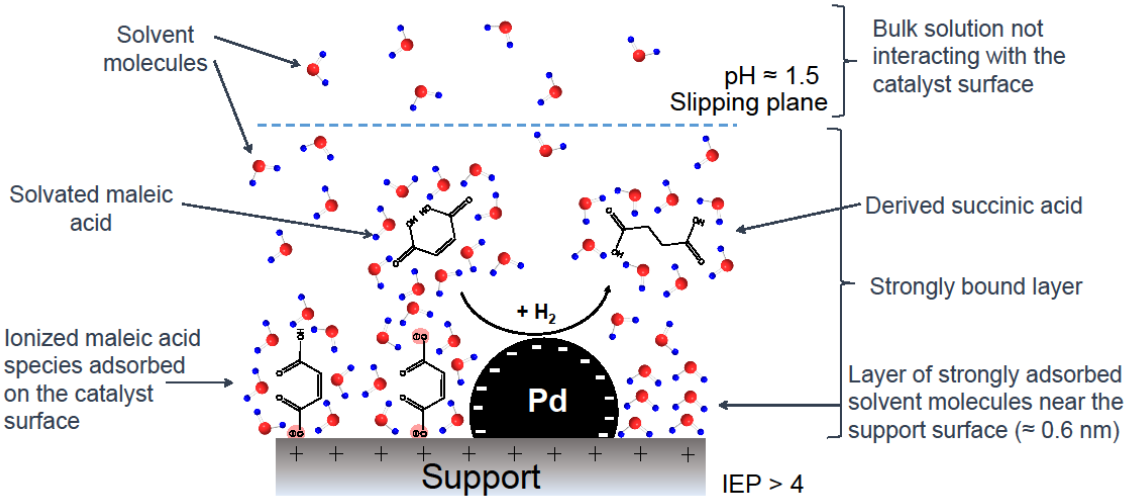
Graphical abstract



Highlights:

- In contrast to ethanol medium, support nature alters Pd catalytic activity in water.
- XPS data of supported Pd electronic state do not correlate with TOF values.
- A near-surface solution structure may govern aqueous maleic acid hydrogenation rate.
- Observed Pd catalytic activity depends on its interparticle distance on the surface.
- High viscosity inside a pore can explain low TOF values of Pd on porous supports.

ABSTRACT

Influence of the support nature on catalytic properties of the supported Pd nanoparticles in liquid-phase (water, ethanol) hydrogenation of maleic acid (MA) to succinic one was extensively studied. Different oxides (SiO_2, diatomites, WO_3, Ta_2O_5, Nb_2O_5, V_2O_5, TiO_2, CeO_2, ZrO_2, Ga_2O_3, In_2O_3, Cr_2O_3, Fe_2O_3, Al_2O_3), salts (CaF_2, $BaSO_4$) and carbon supports either with extremely low or high porosity were employed as the catalyst supports. XPS studies of the catalysts revealed no significant support-induced changes of the electronic state of the active component. For palladium on non-porous supports, its TOF values in MA hydrogenation turned to be constant in ethanol medium but varied with the support nature in water. In the case of porous supports, the TOFs diminished in both mediums and governed by mean pore size and surface acidity the supports. The dependence of TOF values on mean distance between adjacent Pd nanoparticles is also revealed. The catalytic results are explained by the presence of the electric double layer at the catalyst-solution interface, which affect its catalytic performance.

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