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Reactions of radicals at nanoparticles surfaces

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Radicals reactions are of importance due to their formation near surfaces in a variety of processes, e.g. in catalytic processes, in electrochemistry, in photo-catalytic processes, in environmental processes, etc. It was therefore decided to study the mechanisms and kinetics of reaction of M°-NPs, M=Ag; Au; Cu; Pt; Pd, Pt/Au-alloy-NPs and TiO_2-NPs with methyl radicals. (All the M°-NPs were prepared by reduction of the corresponding salts with $NaBH_4$). These reactions are very fast, approaching the diffusion-controlled limit, forming long-lived transients with (M°-NP)-$(CH_3)_n$ σ bonds. These transients decompose yielding C_2H_6 for Ag°-, Au°- and TiO_2-NPs, CH_4 for Cu°-NPs, for Pt°- and Pd°-NPs most methyl remain bound to the NPs, and are released as methane when H_2 is added to the suspension, though some C_2H_6, C_2H_4 and oligomerization products are formed. The reaction of $.C(CH_3)_2OH$ radicals with SiO_2 supported metal-NPs (M°-SiO_2-NCs, NCs=nanocomposites) is more complicated. At low [M°-SiO_2-NCs], the NCs catalyze the reduction of water by these radicals, for M=Pt the NCs are clearly a catalyst while the Pt°-NPs are not; For M=Ag the NCs catalyze the reduction of water but considerably less than the Ag°-NPs; for M=Au both the MPs and the NCs catalyze the reduction of water. At high [M°-SiO_2-NCs] the reduction of water is considerably decreased and at high doses of radicals the Pt°- and Ag°-NCs do not catalyze the reduction of water by the $.C(CH_3)_2OH$ radicals and induce their disproportionation, and their reduction by H_2, on the NCs surfaces. Thus, the SiO_2 support affects considerably the properties of the M°-NPs and the nature of this effect depends on the nature of the M°-NPs.

Biography

Tomer Zidki has completed his PhD in 2009 at Ben-Gurion University of the Negev and has his expertise in "Mechanistic studies of catalytic reactions at nanoparticles surfaces". His studies show that radicals react extremely fast with metal and supported metal nanoparticles. The products of these reactions are long-lived metal-carbon intermediates in which their lifetime depends on the metal nature. He also has interest in "Catalytic water splitting reactions" and developed very efficient water oxidation catalysts based on co-hydrous-oxide nanoparticles supported on SiO_2 nanoparticles. Recently, he developed new metal-alloys nanoparticles which show superior catalytic activity as well as TiO_2 based nanocomposites which will be used for various catalytic and photocatalytic reactions.

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