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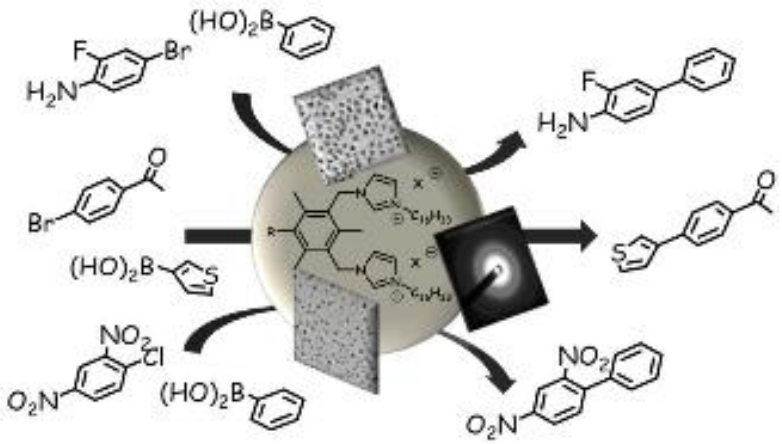
Palladium-carbene interactions in nanoparticles improve the catalytic activity



Nanoscience and nanotechnology are areas of research that are currently in expansion and development. Metallic nanoparticles have arosen a great interest in the last decade because of its properties and the advantages in the field of catalysis, by increasing the rate of chemical reactions. This study, conducted at UAB, has noted the presence of carbenic species on the surface of the palladium nanoparticles. It has been found that nanoparticles with palladium-carbene interactions exhibit better catalytic activity in the reactions leading to the formation of C-C bonds that nanoparticles that do not present this type of interactions.

The areas of nanoscience and nanotechnology are currently undergoing intense development and expansion. In the last decade, metal nanoparticles, defined as aggregates of atoms between 1 and 100 nm in size, have attracted a great deal of attention due to the particular physical and chemical properties imparted by their size. Moreover, the high number of metal atoms on their surface offers certain advantages for their use in catalysis.

Several stabilizing agents are used in the preparation of nanoparticles to prevent their agglomeration, among which we can find the imidazolium salts. In this context, the work has

been focused on the use of tris-imidazolium as stabilizers in the formation of Palladium nanoparticles. Their preparation was carried out through the decomposition of an organometallic complex of Pd under hydrogen pressure, at room temperature and in the presence of the imidazolium salts. The influence of the type of cation and anion on the stabilizing ability of the salts and on the catalytic properties of the resulting metallic nanoparticles has been studied.

The Pd nanoparticles were tested in the Suzuki cross-coupling reaction between arylboronic acids and several aryl bromides and chlorides with yields going from good to excellent. In this type of reactions new carbon-carbon bonds are formed and the importance of these reactions in organic synthesis was clearly evidenced by the award of Nobel Prize in Chemistry 2010 to Akira Suzuki.

With some of the stabilizers used, it has been observed the presence of carbenic species on the surface of palladium nanoparticles. These nanoparticles with surface-bound carbenes have shown better catalytic activity in the carbon-carbon bond forming reactions than those nanoparticles lacking Pd-carbene interactions.

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References

“Palladium nanoparticles in Suzuki cross-coupling: tapping into the potential of tris-imidazolium salts for nanoparticle stabilization” Planellas, M.; Pleixats, R.; Shafir, A. Adv. Synth. Catal.. 2012, 354, 651-662.

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