

## Catalytic applications of Carbons, main issues discussed during The World Conference on Carbon 2018

M. Olga Guerrero-Pérez. *Departamento de Ingeniería Química. Universidad de Málaga*

Carbon Materials found many interesting applications in catalysis and subsequently there were many papers that were discussed in this topic during the Carbon 2018 conference, including 4 keynotes, 27 oral and 38 poster presentations, a total of 69 papers. The first keynote was given by Juan Matos, from University of Concepción, to show the advances in the production of solar fuels using efficient carbon-based photocatalysts. The second one, by Akira Takatsuki, described the use of oxidized carbon powder as catalysts for the hydrolysis of cellulose, that constitute a promising method for the selective conversion of cellulose to glucose. Zhao Quingshan presented the third keynote lecture, in which it was presented a novel nitrogen-doped porous carbon supported Pd nanoparticles as an efficient catalyst for C-N allylation coupling reactions. In this work, the porous carbon material was prepared by a hard template-oriented method and using inexpensive petroleum asphalt as raw material, and urea as nitrogen source. It was shown how the N-doped carbon material induced a uniform dispersion of Pd catalysts and adjust the electronic environment of the catalytic sites. The fourth keynote was given by Diego Garcés, and described the use of carbon materials as co-catalysts and as catalytic supports for biomass upgrading processes, considering the route of cellulose to biogenic aldehydes with further transformation of those aldehydes into long chain hydrocarbons and chemicals via aldol condensation and hydrogenation. The use of the carbon materials as co-catalysts enhanced the mass transfer of the aldehydes from aqueous to organic phase improving reaction rates and limiting further transformation of the aldehydes into humics. Carbon based supports such as carbon nanofiber of high surface area graphites improved the performance of the catalysis during the aldol condensation step. This better performance was explained in terms of a more appropriate basic sites distribution and in the interaction of the reactants with the carbon surface.

Some of the oral presentations were on the use of carbon materials as catalysts for the oxygen reduction reaction (ORR), since the use of carbon cathode catalysts in polymer electrolyte fuel cells instead of the present platinum catalysts is attracting increasing interest. In this sense, several presentations described promising results with the use of nitrogen containing carbon materials containing transition metal-nitrogen coordination structures (M-N-C materials), including CNTs and graphenes. Another important issue that covered by some of the oral presentations was the photocatalytic processes. The use of carbon materials as additives to semiconductors has been proven as an effective strategy for enhancing the photocatalytic performance of the semiconductor with the resulting hybrid semiconductor/carbon material typically

displaying an enhanced catalytic performance under sunlight. During the conference, papers on the use of graphene oxide on photocatalytic water splitting was presented, as well as an ecotoxicity risk assessment for the photodegradation of synthetic and industrial wastewater using  $\text{TiO}_2$  and  $\text{TiO}_2$ /carbon photocatalysts. Also a presentation described the use of Cu/carbon spheres as catalyst for the  $\text{CO}_2$  photo electrochemical reduction. Another group of papers described the use of carbon materials as catalysts for different biomass waste upgrading processes, such as sugar hydrogenation on Ru supported carbons, dehydrogenation of alkanes on nanostructured carbons, hydrolysis of biomass on modified carbon xerogels, or cellulose conversion into sugars. In this sense, also presentations focused on the preparation of catalytic materials from waste valorization such as Pd catalysts supported on activated carbons from lignin. As well as these oral presentations, the 38 posters also focused in this main topics (electrochemical and photochemical catalytic applications of carbon materials and on the upgrading of biomass waste). Also some of them focused on the synthesis of carbon materials with acid properties for esterification and condensation reactions, as well as alcohol decomposition.

Thus, all these papers showed the potential of carbon materials as catalysts, catalytic supports and as co-catalysts in some of the most important catalytic processes that have to be developed during the next years in order to cover the energy, environment, and sustainable issues that the humanity should face. The papers presented during the Carbon Conference have shown how these versatile materials found hundreds of applications in electrochemistry and in photocatalysis, as well as other classical applications, such as acid-based catalysts, that are also important for waste valorization.