

Carbon-based catalysis and photocatalysis: From classical active sites to confining pore effect and defining a new surface reaction-rate constant

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In this plenary, a journey from the classical metal- and semiconductor-based to a sustainable metal-free carbon-based catalysis and photocatalysis will be presented. Several examples from our group and other groups will show the importance of the classical definition of the metallic active-sites and the influence of the pore size distribution of carbon-supports upon the intermediate products in gas-phase heterogeneous catalytic processes related with energy production and selective catalysis. Then, the influence of carbon-based materials in aqueous-phase photocatalytic reactions related with environmental remediation, energy production and fine chemicals synthesis will be discussed as an opening act to highlight the potential of the confining pore effect of nanoporous carbons and the intrinsically photochemical activity of heteroatom-containing surface functional groups.

It is concluded that for a correct description of the active sites in metal-free and semiconductor-free catalytic and photocatalytic reactions, a new defining of the catalytic turnover frequency or the reaction-rate kinetics constant in terms of the textural and surface properties is required. In this sense, our group have proposed a global surface reaction-rate constant based on the surface density of adsorbed molecules to stablish the efficiency of metal-free carbocatalysts. This new kinetic parameter permits to normalize the apparent rate-constants and to correlate directly the catalytic and photocatalytic activity with the pore size distributions and chemical surface groups of nanoporous carbons.