

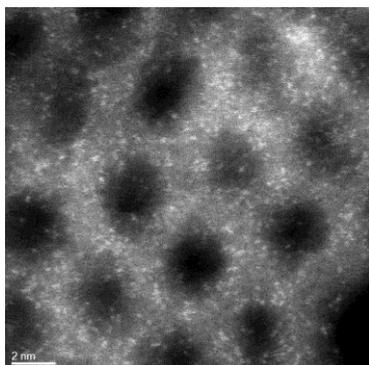
Nanometal fluoride catalysts: synthesis, acidic properties and catalytic applications

Context

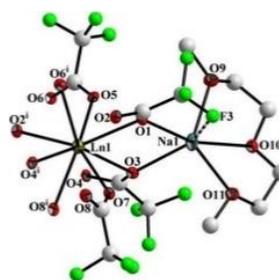
The weakest point of heterogeneous catalysts lies most likely in the heterogeneity of their surface. This leads to low atom efficiency and low selectivity. Recently, single-atoms catalysts (SACs) are emerging as a new ideal in this field with evident advantages, enhanced catalytic activity, improved control of selectivity but also new activities linked to the nature of the active centers i.e., isolated atoms dispersed on the surface [1,2]. While SACs deals mainly with noble metals [3-7], reseachers from the "Sustainable Chemistry" team at IRCELYON have reported the synthesis of transition metal oxides atomically dispersed within mesostructured silica supports [8]. These superficial isolated metal centers (Nb, Ta, W, Ti, Mo, Zr) are strongly anchored on the high-surface area supports, therefore, preventing by this way the tendency of isolated metals to aggregate. Moreover, these atomically dispersed transition metals in a neutral silica support leads to the appearance of superficial active centers, i.e. transition metal ions of variable oxidation states and coordination numbers, with Lewis/Brønsted acid properties. These materials were found to be excellent catalyts for the synthesis of butadiene from ethanol [8]. Besides, the "Susatiable Chemistry" team at IRCELYON, gathers scientists with expertise on molecular precursors of metals (M = Nb, Ta, Al, Sb...) with fluorinated ligands, to get metal fluoride nanomaterials for energy [9]. This PhD project deals with the use of these original fluorinated metallic precursors to design new fluorinated and ultradispersed metallic catalyts.



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HRTEM-HAADF of Ta(3.8%)@MCM-41 [8]



Example of fluorinated metallic precursors NaY(TFA)₄(diglyme) [9]

The controlled introduction of F ions in the coordination sphere of the metallic ions anchored in the silicious matrix will strengten the Lewis/Brønsted acid strength of the catalysts. From this, many catalytic applications are expected: from the conversion of renewable substrates such as light alcohols or carbohydrates up to light alkanes activation which requires superacids sites such as fluorinated alumina.

The study will rely on the complementary expertises gathered in the « Sustainable Chemistry » team at IRCELYON : synthesis of original fluorinated molecular precursors and fluorinated ultradispersed metallic catalysts, charaterization of their acidic properties (via adsorption of probe molecules monitored by FTIR, calorimetry) and catalytic applications : butadiene synthesis from éthanol or polyols.

References

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Profil of the candidate

Candidates should hold a Master of Sciences degree with knowledge/hand-on experience in materials synthesis and characterizations and catalysis.

Contract: PhD fellowship from 01/10/2019 to 30/09/2022

Salary: 1300 euros /month.

Application details send a CV, a cover letter and two recommendation letters to

Dr Essayem (nadine.essayem@ircelyon.univ-lyon1.fr)

Dr Mishra (shashank.mishra@ircelyon.univ-lyon1.fr)

before 30/05/2019. The attribution of the PhD fellowship is based on the excellence of academic records of the candidate.