Supporting Information

A direct novel synthesis of highly uniform dispersed ruthenium nanoparticles over P6*mm* ordered mesoporous carbon by host/guest complexes

N. Gokulakrishnan,[a,b,c] G. Peru,[a,b,c,] S. Rio,[a,b,c] J. F. Blach,[a,b,c] B. Leger [a,b,c] D. Grosso,[d] E. Monflier, [a,b,c] and A. Ponchel* [a,b,c]

[a] Univ Lille Nord de France, F-59000 Lille, France

[b] UArtois, Unité de Catalyse et Chimie du Solide (UCCS), Faculté des Sciences Jean Perrin, Rue Jean Souvraz, F-62300 Lens, France

[c] CNRS, UMR 8181, F-59650 Villeneuve d'Ascq, France

[d] Laboratoire Chimie de la Matière Condensée de Paris, UMR-7574, Collège de France, 11, place Marcelin Berthelot, 75231 Paris, France

* Corresponding Author.

Fax: +33-3-2179-1755, e-mail: anne.ponchel@univ-artois.fr

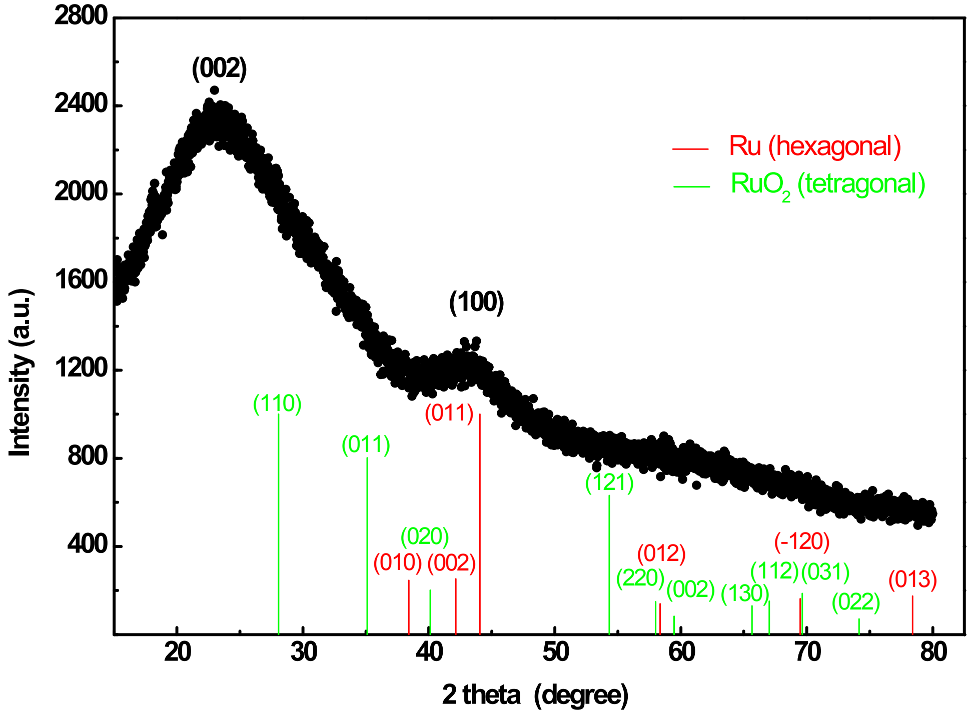

Figure S1. Wide angle XRD pattern of the Ru@MCA2 material. *The diffraction peaks are indexed to pure Ru (hexagonal structure [1], red lines) and RuO_2 (tetragonal structure [2], green lines).*

The wide angle XRD analysis of the composite material prepared from host-guest complex and $RuCl_3$ (Ru@MCA-2) is given in the Figure S1. Experiments were conducted on a Bruker D8 Advance diffractometer in Bragg-Brentano geometry equipped with a copper anode (λ=1.5418 Å) and a 1D PSD Lynxeye detector. The scattering intensity was measured over an angular range of 15°< 2θ□< 80° with a step-size of Δ(2θ)= 0.02°.

The XRD pattern shows a broad peak at 2θ = 23° and a less intense peak at 2θ = 44° attributed to the (002) and (100) diffraction peaks in carbon materials, with limited domain sizes of stacked crystalline graphite. No reflection peaks of ruthenium in the form of metallic or oxide phase emerge from the XRD pattern, indicating that the ruthenium phase forms very small particles within the carbon matrix, which cannot be detected by wide angle XRD analysis [1,2].

[1] R. W. G. Wyckoff, In *Crystal Structures*. Second Edition, Interscience Publishers, Vol. 1, pp. 7–83, New York, 1963.

[2] J. Haines, J. M. Léger, O. Schulte and S. Hull, *Acta Crystallogr. Sect. B*, 1997, **53**, 880.

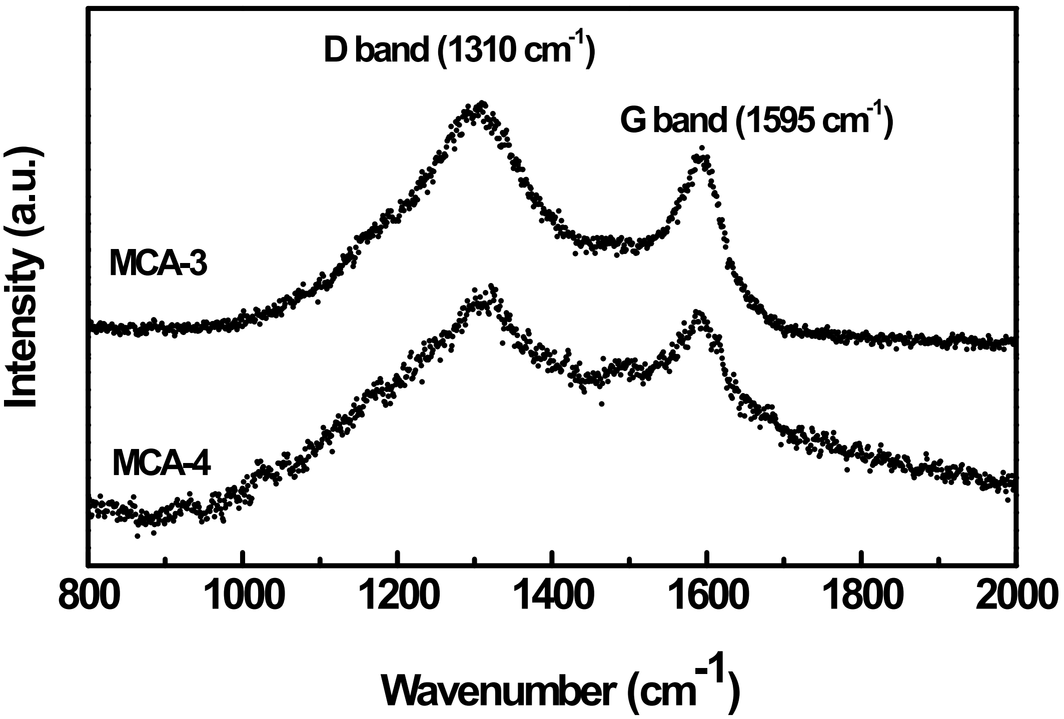

Figure S2. Raman spectra of the MCA-3 and MCA-4 synthesized materials in the spectral region 800-2000 cm^{-1}.

Table S1. Textural characteristics and Boehm's titrations of the control carbon supports

Carbon	S_{BET} (m^2 g^{-1})	V_{tot} ($cm^3.g^{-1}$)	V_{micro} ($cm^3.g^{-1}$)	% micro[a]	Average pore diameter (nm)	Titration results (µmol g^{-1})[b]
AC-WV	1690	1.32	0.54	41	3.1	39
AC-NorA	1207	0.71	0.42	60	2.4	539

[a] Relative percentage of microporosity defined as the ratio of the micropore volume to the total pore volume.

[b] The Boehm's titration method was used to determine the number of acidic and basic groups [1]. In a typical experiment, 1.0 g of carbon sample was equilibrated for 24 h with 50 mL of NaOH solution (0.05 mol L^{-1}). Then, 5 mL of each filtrate was titrated with HCl (0.05 mol L^{-1}). The numbers of acidic sites were calculated from the assumption that NaOH neutralizes carboxylic, phenolic, and lactonic groups,. Basic surface sites were determined similarly by using HCl solution (0.05 mol L^{-1}) as reactant.

[1] H.P. Boehm, Carbon 32 (1994) 759.