



VII Encuentro Argentino de Materia Blanda

Chimie Douce based strategies towards Hierarchically Structured Functional Materials

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Inorganic and Hybrid inorganic-organic nanomaterials can be broadly defined as synthetic materials with organic and /or inorganic components which are designed via colloidal chemistry. They can be either homogeneous systems derived from monomers and miscible organic and inorganic components, or heterogeneous and phase-separated systems where at least one of the components' domains has a dimension ranging from a few Å to several nanometers. These "chimie douce" based strategies can also be used to texture new inorganic or hybrid nanomaterials that can be dense or with controlled porosities. The versatile synthetic conditions provided these strategies makes possible to tailor made new materials and fine-tune their properties (mechanical, optical, electronic, thermal, chemical...) in very broad ranges, and to design specific systems for applications. These materials can be processed as gels, monoliths, thin films, fibers, particles or powders or can be intermediates to design materials having complex shapes or hierarchical structures. The seemingly unlimited variety, unique structure-property control, and the compositional and shaping flexibility give these materials a high potential in catalysis, biocatalysis, photocatalysis, nanocarriers, fuel cells etc.... This plenary lecture will describe some recent advances on integrative chemistry based strategies that allows via a chemistry-process coupling to tailor made nanostructured and hierarchically structured functional inorganic and hybrid materials. Some of their properties will be quickly discussed. For more information see few reviews of the field.:

History of Organic-Inorganic Hybrid Materials: Prehistory, Art, Science, and Advanced Applications, M Faustini, L Nicole, E Ruiz-Hitzky, C Sanchez, *Advanced Functional Materials*, 1704158 (2018); Aerosol processing: a wind of innovation in the field of advanced heterogeneous catalysts, DP Debecker, S Le Bras, C Boissière, A Chaumonot, C Sanchez, *Chemical Society Reviews* 47 (11), 4112; Optical Properties of Hybrid Organic-Inorganic Materials and their Applications. Parola S., Julián-López B., Carlos L. D., Sanchez C. (2016). *Advanced Functional Materials*, 26(36):6506-6544. ; The core contribution of transmission electron microscopy to functional nanomaterials engineering, Carenco S, Moldovan S., Roiban L., Florea I., Portehault D., Valle K., Belleville P., Boissière C., Rozes L., Mézailles N., Drillon M., Sanchez C., Ersen O., (2016). . *Nanoscale*, 8(3):1260; "Chimie douce": A land of opportunities for the designed construction of functional inorganic and hybrid organic-inorganic nanomaterials C. Sanchez, L. Rozes, F. Ribot, C. Laberty, D. Grosso, C. Sassoie, C. Boissiere and L. Nicole, *Comp. Rend. Chimie*, 13, 3, (2010); Molecular Engineering of Functional Inorganic and Hybrid Materials, C. Sanchez, C. Boissiere, S. Cassaignon, C. Chaneac, O. Durupthy, M. Faustini, D. Grosso, C. Laberty-Robert, L. Nicole, D. Portehault, F. Ribot, L. Rozes, and C. Sassoie. *Chemistry of Materials* 2014 26 (1), 221-238; Nanoscaled Metal Borides and Phosphides: Recent Developments and Perspectives, Sophie Carenco, David Portehault, Cédric Boissière, Nicolas Mézailles, and Clément Sanchez. *Chemical Reviews* 2013 113 (10), 7981-8065; Aerosol Route to Functional Nanostructured Inorganic and Hybrid Porous Materials , Boissiere, Cedric; Grosso, David; Chaumonnot, Alexandra; C. Sanchez. *Advanced Materials*, Volume: 23 Issue: 5 Pages: 599-623 , 2011; Applications of advanced hybrid organic-inorganic nanomaterials: from laboratory to market Sanchez, Clement; Belleville, Philippe; Popall, Michael; et al. *Chemical society Reviews* Volume: 40 Issue: 2 Pages: 696-753, 2011; Biomimetism and bioinspiration as tools for the design of innovative materials and systems , Sanchez, C; Arribart, H; Giraud-Guille, MM, *Nature Materials*, Volume: 4 Issue: 4 Pages: 277-288 2005; Debecker, D. P.; Le Bras, S.; Boissière, C.; Chaumonnot, A.; Sanchez, C., Aerosol processing: a wind of innovation in the field of advanced heterogeneous catalysts. *Chemical Society Reviews* 2018. 47, 4112-4155; Sanchez, C.; Soler-Illia, G. J. A. A.; Ribot, F.; Grosso, D., Design of Functional Nanostructured Materials through the Use of Controlled Hybrid Organic-Inorganic Interfaces. *Comptes Rendus Chimie* 2003, 6 (8-10), 1131-1151.; Soler-Illia, G. J. A. A.; Sanchez, C.; Lebeau, B.; Patarin, J., Chemical Strategies to Design Textured Materials: From Microporous and Mesoporous Oxides to Nanonetworks and Hierarchical Structures. *Chemical Reviews* 2002, 102 (11), 4093-4138.; Sanchez, C.; Soler-Illia, G. J. A. A.; Ribot, F.; Lalot, T.; Mayer, C. R.; Cabuil, V., Designed Hybrid Organic-Inorganic Nanocomposites from Functional Nanobuilding Blocks. *Chemistry of Materials* 2001, 13 (10), 3061-3083.

