FORTH / ICE-HT

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SPEAKER: **Dr. Jean-François Gerard**
Ingénierie des Matériaux Polymères - Laboratoire des Matériaux Macromoléculaires
UMR CNRS #5627 IMP INSA Lyon, France

THEME: **Nanostructured polymers from assembling hybrid organic/inorganic nanobuilding blocks**

PLACE: FORTH/ICE-HT auditorium

DATE: Monday, 7th of May, 2007

TIME: 12:00

ABSTRACT: The Hybrid nanocomposite materials, denoted I/O hybrids, based on an inorganic phase and an organic phase that can be physically mixed (Type I I/O hybrids) or covalently connected at a nanometer level (Type II I/O hybrids) are of a large interest to combine the properties of the organic and inorganic moieties and nanostructured materials. In fact, a large variety of architectures and morphologies can be designed. Thus, such materials could be considered as innovative advanced materials and promising application are expected in many fields, such as optics, electronic, mechanics, membranes, protective coating, catalysis, sensors, etc.

The conventional route for processing such materials involves the well-known sol-gel chemistry that allows to synthesize the final material starting from molecular metal precursors combined with monomers , oligomers, or polymers. The synthesis is based on the hydrolysis and condensation of organico-modified metal alkoxides i/ in the presence of a polymer or ii/ organic monomers as well as iii/ grafted groups on an organic oligomer. Such a route, which can be done in soft conditions, implies a precise control of the different steps and reaction conditions such as pH, temperature, stoichiometric ratio, rate for solvent and volatile moities, etc. A better definition on the organic-inorganic interface can be achieved by use of defined organic-inorganic bricks, i.e. nanobuilding blocks such as metal-oxo clusters which can be assembled from their homopolymerization or copolymerization with organic precusors, i.e. monomers or functional oligomers. The well-known POSS, polyoligomeric silsesquioxanes, are one type of such metal-oxo clusters. In fact, the introduction of an inorganic nanophase having a controlled reactivity with the surrounding polymer chains could allow to i/ design nanostructured linear polymers or networks ii/ understand the proper length scale at which the design of an inorganic phase needs to be done or the architecture of the I/O nano-object. The purpose for choosing to use I/O nanoclusters instead of preformed inorganic nano-objects such as fumed silica is related to the fact that they are smaller than those conventional inorganic objects and one can consider them as a molecule or as a nanofiller particle. As a consequence, the final question is: Are such nanobuilding blocks efficient nanofillers ? What type or combination of properties can be achieve from the use of such I/O nanoclusters?

In this lecture, different synthesis routes for designing new nanostructured polymer materials, i.e. nanocomposites or hybrid organic-inorganic nanomaterials, are described with a special emphasis of that one based on the introduction and assembling of organic-inorganic nanobuilding blocks, methacrylate-polyoligomeric silsesquioxanes, POSS, (mono and multifunctional) or titanium based nanoclusters, methacrylate-functionalized Ti16O16(OEt)32. The different routes are reviewed for a given type of polymer chemistry, i.e. free radical polymerization of methacrylate or dimethacrylate monomers leading to nanostructured thermosets of thermoplastics. These syntheses used for processing hybrid organic-inorganic materials from neat organic polymer (TP or TS) to organic/inorganic materials based up to 15 wt.% of inorganic phase will be used to compare the achieved properties of the resulting O/I nanomaterials.

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