Synthesis of multiferroic coordination networks from imidazolium multicarboxylate salts.

This thesis aims at developing a new strategy for the synthesis of intrinsic multiferroic materials by using a “lego®-like” hybrid organic-inorganic approach. Multiferroic compounds are particularly interesting due to their high potential for low-energy electronics and information storage. However, the main difficulty remains the obtaining of multiferroic compounds where the ferromagnetic and the ferroelectric properties are coupled (or intrinsic multiferroic).[1,2] Although the examples of multiferroic materials are relatively scarce and largely covered by the oxides, some examples of multiferroic metal-organic networks have been reported recently with possible synergy between the magnetic and dielectric properties.[3,4] These networks are classically obtained by solvothermal reactions (neutral ligands and metal salts are heated in a solvent) and recently by ionothermal synthesis (the solvent is then replaced by an ionic liquid). In our group, we have chosen to synthesize this sort of networks from imidazolium multicarboxylate (or solvo-ionothermal synthesis). Following this strategy, we have obtained networks (thesis of Pierre Farger)[5] with different properties (luminescence, magnetism, nonlinear optics).[6,7] In the particular case of the compound \( \text{[Gd}_2\text{L}_2\text{C}_2\text{O}_4\text{H}_2\text{O}_2] \) obtained from a chiral imidazolium salt, we have evidenced a ferroelectric order. However, the magnetic behavior of these networks is essentially characteristic of low dimensional network.

Based on these results, this thesis aims the establishment of a magnetic order (ferro ou ferri) in this sort of networks. To achieve this objective, two tracks will be explored (Figure 1). The first one is based on the synthesis of new imidazolium salts being able to favor the formation of networks with higher dimensionality. The second one is based on the synthesis of heterometallic networks being able to favor a ferrimagnetic order.

![Figure 1](image_url)  
*Figure 1 : Examples (a) of novel imidazolium salts and (b) of structure useable for the « ferri » approach.*

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References