EVIDENCE FOR MICROSTRUCTURE-DEPENDENT HYSTERESIS IN SCO MOLECULAR CERAMICS PREPARED BY COOL-SPS

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In recent decades, the development of new molecular materials with spin transition has aroused a growing interest from scientists in the field of information and communication technologies [1]. These compounds have the capacity to change their electronic state under the effect of an external disturbance such as temperature, pressure, or light irradiation, with important consequences on their structural, magnetic, or optical properties making them attractive for potential applications in the field of sensors, memories, molecular motors, or smart pigments. If the relations between the properties of these compounds and the crystalline structures are well established [2], the effects related to their microstructure were recently highlighted [3] and are still being discussed. Recently, the efficiency of Cool-SPS for the sintering of fragile materials at low temperature was established [4] Cool-SPS allowed the first molecular ceramics to be obtained at ICMCB [5]. Current work aims to develop new molecular ceramics from functional materials such as spin-transition complexes, to extend their diversity and to establish relationships between the microstructures obtained, their physical properties, and their switching behaviors. The compound $[Fe(Htrz)_2(trz)](BF_4)$ was chosen as starting material because the switching of the Fe^{2+} ion between a diamagnetic low spin state (LS, S=0), and a paramagnetic high spin state, (HS, S=2) is carried out with a large thermal hysteresis (~ 40K) above the room temperature [6]. Moreover, the importance of the microstructure on this compound is known [7], and recent work has shown a clear evolution on this scale following several cycles or heat treatments [8]. In this work, first molecular ceramics from SCO materials have been developed by Cool-SPS, the optimal sintering conditions will be discussed, the influence of the sintering parameters (temperature, pressure, etc.) on the structural and morphological properties will be studied, and the correlation between microstructure and hysteresis loop after sintering will be highlighted (Figure 1). The future work, within the framework of this thesis, aims to pay attention to a further characterization of the ceramics elaborated in order to investigate the influence of the sintering conditions on the physical properties of the powders and to study in detail the relationship between the microstructural properties and the physical properties. SPS treatment conditions will be optimized to obtain denser ceramics while controlling their microstructure.

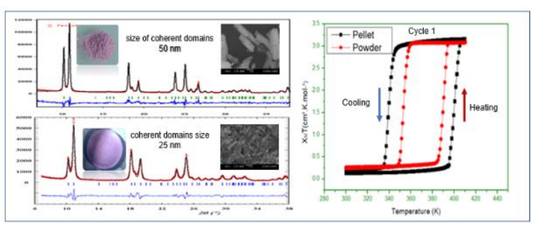

Figure 1 – Profile matching of the PXRD pattern, TEM images and VSM first cycle of the $[Fe(Htrz)_2(trz)](BF_4)$ respectively before and after sintering.

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