Magnesium nanoparticle materials synthesized from serpentinite

Bernard Aristeu R. França[1], **Victor S. Vaz[2]**, **Maria Helena Araújo[3]**, **Ana Paula C. Teixeira[4]**

[1]*Chemestry Departament, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil*
E-mail: bernardtrcfranca@gmail.com

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Serpentinite is a rock from the serpentinite group, and it has a general composition written as $Mg_3Si_2O_5(OH)_4$ [1]. It has large reserves around the entire globe, especially in Brazil being the third largest source on the planet[2]. It is speculated that are hundreds of millions of tons worldwide[2]. The rock contains significant amounts of ions such as Mg^{2+}, Fe^{2+}, Fe^{3+}, Si^{4+}. Because of this serpentinite serves as a source of these metals and is widely used in various applications, including ceramics, composite production, steelmaking, metallurgy and agricultural soil correction[1]. In particular, we can highlight the use of magnesium ions in this for the synthesis of compounds as $Mg(OH)_2$ and their nanoparticles, which have high commercial potential. Focusing on its applications, we can cite as an example: the use of its nanoparticles as a non-toxic commercial flame retardant[3]. To separate the ions in this project, acid leaching was used on the rock. This process results in a solid rich in silicate and a solution with metallic ions. By adding an alkaline solution, the Fe^{2+} and Fe^{3+} ions are precipitated, resulting in a concentrated magnesium solution, which served as source of Mg^{2+} in this study. Two different methods were used to synthesize the materials: precipitation and hydrothermal. In the first one, an alkaline solution is carefully controlled when added to the magnesium precursor, and the mixture is magnetic stirred for a period of time to allow the entire reaction to occur[4]. The second one involves using a reactor coated with a teflon cup, and instead of the agitation time, we place this reactor in an oven at 170˚C[5]. In all synthesis methods, parameters were altered to obtain materials with different morphologies and particle sizes. These materials were characterized using several techniques. Thermogravimetric analysis (TG) revealed curves that are similar to pure commercial materials. This complements the results of the second technique, which is X-ray diffraction (XRD). Through the diffractograms, well-defined peaks of highly pure and crystalline $Mg(OH)_2$ materials can be observed. The third characterization technique was nitrogen physisorption, which exhibited type IV isotherms and H3 hysteresis, a characteristic of materials in the form of aggregated plates, resulting in slit-shaped pores that can be seen in the fourth characterization method, scanning electron microscopy (SEM), which by analyzing the samples, allows us to observe particles of various sizes and morphologies. By comparing the different materials obtained from the parameters used in the synthesis. We were able to synthesize $Mg(OH)_2$ particles using serpentinite, including particle with different morphologies and properties. These will be evaluated for various applications, and we expect to develop more efficient synthesis processes and explore recent methodologies to obtain more dispersed and smaller materials in the near future.

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