



Thortveitite and thortveitite-like layered compounds

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ABSTRACT

In this article we present the main features and structural relationships between the thortveitite structure (S.G. $C2/m$) and thortveitite-like compounds (S.G. $P21/m$ and $C2/c$). Some of them were synthesised and characterised in our laboratory and some others were reported in the literature.

INTRODUCTION

The vertiginous rise of science and technology has produced the research and development of different materials presenting valuable physical properties. Among them we have rare earth compounds, being of special interest mainly because of the possibility of their use in diverse areas of modern engineering and technology. Luminophores, quantum generators, optical converters, scintillators, etc. are some illustrative examples of this matter [1-4]. Silicates of rare earth metals for instance have been synthesised because of their potential applications in refractory and semiconducting materials and also as host crystals in quantum electronics [5-7]. Rare earth germanates can find broad application in radioelectronics (as laser materials), in luminophore production (luminophores covering the whole optical radiation range, X-ray luminescent screens, thermoluminescent dosimeters), in glass-ceramic manufacture (special kinds of glass and ceramics), in the nuclear instrumentation industry (nuclear radiation detectors), and in numerous other capacities [4]. In rare earth phosphates, the optical properties have been considered the focus of technological applications because the possibility of obtain phosphors materials, which are inorganic compounds that luminesce under an excitation source

(e.g. electron beam, UV photons, electric field) and are composed of a host (transparent to excitation source) and an activator, typically a $3d$ or $4f$ electron metal [8]. The luminescence arises from electronic transitions of the activator. Ropp [9] has reported the emission spectrum of Eu^{3+} in LnPO_4 ($\text{Ln} = \text{Tb}$ to Lu). In his work Ropp also compared the emission intensities of rare earth phosphates with those produced in rare earth oxide phosphors. The highly efficient Tb^{3+} -doped phase ($\text{La}_x\text{Tb}_y\text{Ce}_z\text{PO}_4$, monazite, has been used as green phosphor in fluorescent lamps [10-12]. Some efforts have been carried out to prepare and characterise a wide variety of rare earth doped powder phosphors for their use in colour TV monitors, fluorescent lamps and X-ray intensifying screens [13-15]. Attempts to explore the commercial applications of red, green and blue emitting phosphors by the optimisation of dopant ion concentration (using Eu^{3+} , Tb^{3+} and Ce^{3+} as dopant ions) in lanthanide based phosphors, $\text{LnPO}_4:\text{Re}^{3+}$ ($\text{Ln} = \text{La}$, Gd ; $\text{Re} = \text{dopant ion}$) have been reported by Rambabu et al. [16].

Silicates, germanates and phosphates in general, offer a great opportunity to obtain very interesting physical properties in a built crystal structure by associating a transition $3d$ metal or/and $4f$ rare earth element with covalent phosphorous, silicon, germanium or even arsenic and vanadium as well.

In silicates, germanates, phosphates, arsenates and vanadates having the general formula $\text{M}_2\text{X}_2\text{O}_7$ there is often the thortveitite-like crystal structure. They are composed of M^{n+} cations (rare earth, transition metals, divalent or trivalent elements) in octahedral coordination, and $\text{X}_2\text{O}_7^{2n-}$ anions ($\text{X} = \text{Si}^{+4}$, Ge^{+4} , P^{+5} , As^{+5} and V^{+5}). The frameworks of these phases are built up from corner-sharing MO_6 octahedra forming a hexagonal disposition on layers interspersed with layers