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VO_2 nanostructures, fabrication techniques and applications in smart coatings for green construction

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Abstract

Exterior Smart coatings have attracted a great interest in recent years for energy saving purpose and green construction. Vanadium dioxide (VO2) is a good candidate for smart coating applications because of its promising thermochromic properties. Thermochromic characteristic of VO2 makes it capable of controlling near infrared reflectance in different temperatures. This performance is closely related to the phase composition and the microstructure, which are largely dependent on the synthesis method and growth control. The high phase transition temperature (Tc) of 68 °C becomes the limitation of its practical application. In this work, a hydrothermal fabrication method was developed to prepare W-doped thermochromic VO2 pigment for being applied in smart coatings.

Key words: VO_2, thermochromic, smart coating, nanotechnology, green construction

1. Introduction

Green construction is a term which contains energy saving and preserving natural recourses in order to achieve sustainable development [1, 2]. Over the past years, great efforts have been made to use cool coatings which can reduce the solar energy adsorption in order to decrease the temperature of roof and walls in hot seasons. These coatings have high reflectance of near infrared radiation which is responsible for heat. However highly reflective cool coatings are not preferred in all seasons. In cold season solar adsorption is desired in order to reduce the energy consumption for heating. As a result building coatings which can switch between reflective and absorptive in response to the change of environmental temperature are desired. Thermochromic coatings which are able to change color reversibly between dark and light with the variation of temperature may fulfill this task. As a thermochromic material with semiconductor-to-metal phase transition property that was first reported by Morine [3], VO2 has attracted increasing research interests. The rutile phase of metallic VO2 at high temperatures is found on a simple tetragonal lattice (space group P42/mnm), which is a body-centered orthogonal parallelepiped structure. However, the semiconducting phase of VO2 at low temperatures belongs to the monoclinic crystal system (space group P21/c). The metal-insulator transition (MIT) in VO2 is a first-order reversible transformation with changes in crystal volume at the critical point of the phase transition,