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Submicronic VO2–PVP composites coatings for smart windows applications and solar heat management

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Abstract

Large surface and chemically stable thermochromic composite coatings consisting of IR active sub-micron VO(sub2) particles embedded in a passive polymeric host matrix of Polyvinylphenol were synthesized by dip and spin coating process. The hybrid composite coatings are IR transparent and IR reflective below and above the switching temperature of ~68 degrees C. Although these cost effective hybrid composite coatings are two-dimensional morphologically (1–3 nonpercolated submicron VO2 crystallites within the coating thickness), they exhibit a significant reversible IR transmission modulation with temperature of ~45% between 25 degrees C and 100 degrees C at 1 mm. This satisfactory reproducible thermochromic optical switching characteristic could address the impediment to greater market penetration of thermochromic VO(sub2) based technology relatively to the high cost coatings engineered by vacuum technologies. From technological applications perspective, the global production of glass which could regulate solar heat by using such hybrid thermochromic coatings, could be part of 1 billion m2/year with ~25% for building sector and about ~11% for the automotive industry. Likewise, such cost effective hybrid thermochromic coatings could play a significant role in the minimization of air conditioning load and thus energy consumption in both building and automotive sectors. As hinted to in its 2012 annual report, the International Energy Council's predictions have estimated that with ~2 billions m(sup2) of coated windows worldwide with smart coatings, energy saving in the building and automotive economic fields is equivalent of CO(sub2) reduction by about ~100 millions of tons.