Tungsten doped vanadium oxide thin films by atmospheric pressure chemical vapour deposition.

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Vanadium oxide thin films can be applied to a variety of technological appliances including solid state batteries, electrochromic devices and infrared modulators. In particular vanadium(IV) oxide has been suggested as a potential intelligent window coating (1) due to its metal-to-semiconductor transition (MST) at 68 ºC (2). The transition involves a monoclinic to tetragonal structural change, which is accompanied by dramatic changes in electrical and optical properties. The low temperature phase is infrared transparent while the high temperature phase is infrared reflective.

Doping metal ions into the vanadium(IV) oxide lattice has been shown to affect the transition temperature of the metal-to-semiconductor transition in bulk materials (3) and thin films (4). The direction and magnitude of the switch from VO_2 monoclinic to VO_2 tetragonal depends on the nature of the dopant with tungsten being the most effective at lowering the transition temperature (4).

Tungsten doped vanadium oxide thin films on glass substrates were prepared from atmospheric pressure chemical vapour deposition reaction of vanadium(IV) chloride, tungsten(VI) ethoxide and water. At substrate temperatures > 600 ºC and at 10:1 water to VCl_4 ratio, tungsten doped VO_2 could be produced. The films were examined by micro Raman spectroscopy, glancing angle X-ray diffraction, reflectance-transmittance spectroscopy, X-ray photoelectron spectroscopy, Rutherford backscattering spectroscopy, scanning electron microscopy and energy dispersive analysis of X-rays.

The tungsten-doped VO_2 films displayed lower transition temperatures compared to the pure compound, a desirable effect for the proposed application. The films showed a thermochromic switching that was related to tungsten content as shown in Figure 1.

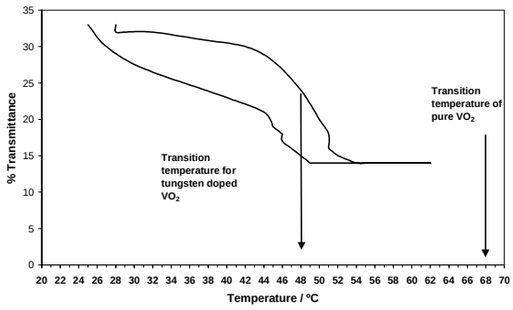

Figure 1. % transmittance at 2.5 μm vs temperature for ~1% tungsten doped VO_2 thin film showing reduced thermochromic transition temperature compared to pure VO_2.

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