STUDY OF THE EVOLUTION OF THE THERMAL EMISSIVITY IN THIN FILMS OF VO_2 DURING THE PHASE TRANSITION TEMPERATURE

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Vanadium dioxide is a thermochromic material that exhibits a reversible metal-insulating phase transition for a critical temperature of 340 K [1]. Due its phase transition occurs at temperatures close to room temperature, the optical, electrical, and thermal properties of this material have been widely studied over the past decades. In this work, radiation heat flux was measured for thin films of vanadium dioxide deposited on R-sapphire (VO_2/R-sapphire) and C-sapphire (VO_2/C-sapphire) using a two-terminal system, placed inside a vacuum chamber with a pressure less than Torr. Emissivity was calculated the measurements of radiation heat flux. For both samples, the hysteresis loop was studied, for heat flux and emissivity, corresponding to the heating and cooling processes. For both, heat flux and emissivity, a lower hysteresis width was obtained for VO_2/R-sapphire. It was also found that the variation in emissivity, between the insulating and metallic phase, is less in VO_2/R-sapphire. In order to analyze the temporal evolution of the transition of the optical properties, the effective Bruggeman model [2] was used as a basis. This is a scheme in which, knowing the properties in the insulating and metallic phase, as well as the fraction of the metallic phase and the depolarization factor, the evolution of the properties in the phase transition can be modeled. Based on the previously reported values for the volume fraction and the depolarization factor [3], it was possible to determine the evolution of the metallic volume fraction as a function of temperature, using our emissivity results. From this, the activation energy of the metallic phase could be determined.

References

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