Relative Optical-To-Thermal Energy Convertion Efficiency of Nio/Ni and Tinox Selective Coatings Measured by Photoacoustic Spectroscopy

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Thermal and optical characterization of materials used in renewable energy industry is a primary need. Photothermal techniques are especially suited to perform such studies, since sample properties can be determined directly from the obtained signals [1]. In thermal solar collectors, an important selective coating property is the efficiency of the coating to convert the incident radiation into heat. This quantity is involved in all the photothermal process and in principle be obtained using the well-known photothermal techniques. In this paper a method to measure this efficiency in selective coatings is presented. The method consists in performing PA measurements using a modified conventional Rosencwaig cell in which the sample closes the cell on one side, and on the other by a transparent window, through which the coating is illuminated by a modulated laser beam from 5 to 2000 Hz. The temperature variations in the air inside the PA cell were detected using an electret microphone coupled to the cell. The efficiency was measured using several wavelengths in the visible up to the near infrared in NiO/Ni and TiNOX selective coatings on aluminum, copper and steel substrates. Interpretation of the experimental data was performed using a one-dimensional thermal wave propagation model approach for a layered system [2,3].

References

[1] Valdes, C., Miranda, J., & Alvarado, J. (2012). Photothermal characterization of the thermal properties of materials using four characteristic modulation frequencies in two-layer systems. *Journal of Applied Phisycs, 112* (064909).

[2] Rosencwaig, A., & Gersho, A. (1976). Theory of the photoacoustic effect with solids. *Journal of Applied Physics, 47* (1), 64-67.

[3] Mandelis, A. (2001).*Diffusion-Wave Fields. Mathematical Methods and Green Function* (págs. 85-164). Toronto: Springer.