Comment on the paper “Microsystem Technologies (2018) 24:4965–4979”

Asterios Pantokratoras¹

Received: 17 January 2020 / Accepted: 16 March 2020 / Published online: 23 March 2020
 © Springer-Verlag GmbH Germany, part of Springer Nature 2020

1 Abstract

In the above paper two serious errors have been found.

In the above paper the heat equation is as follows (equation 18 in Ezzat and El-Bary 2018)

$$\left(1 + \tau_0 \frac{\partial^\nu}{\partial t^\nu}\right) \left(\rho C_E \frac{\partial^2 T}{\partial t^2} + T_0 \gamma \frac{\partial^2 e}{\partial t^2}\right) = (a_1 k + a_2 \tau_a k^*) \frac{\partial^3 T}{\partial t \partial x^2} + a_3 k^* \frac{\partial^2 T}{\partial x^2} + S \sigma_0 \Pi \frac{\partial^2 T}{\partial x^2} \quad (1)$$

where τ_0, τ_a (sec) are the relaxation times, t (sec) is the usual time, ν is a dimensionless exponent, a_1, a_2 are dimensionless coefficients and k (Kelvin⁻¹kg m sec⁻³) is the thermal conductivity. The number 1 is a pure number (dimensionless) whereas the units of the term $\tau_0 \frac{\partial^\nu}{\partial t^\nu}$ are sec^{1- ν} . In Physics it is not allowed to add quantities with different units and for that reason the term $\left(1 + \tau_0 \frac{\partial^\nu}{\partial t^\nu}\right)$ is wrong. This means that the Eq. (1) is also wrong.

Above equation (20) in Ezzat and El-Bary (2018) a series of dimensionless parameters have been defined and the dimensionless equation (21) is as follows

$$C \frac{\partial^3 \theta(x, t)}{\partial t \partial x^2} + A \frac{\partial^2 \theta(x, t)}{\partial x^2} = \left(1 + \tau_0 \frac{\partial^\nu}{\partial t^\nu}\right) \left(\frac{\partial^2 \theta(x, t)}{\partial t^2} + \varepsilon \frac{\partial^2 e(x, t)}{\partial t^2}\right) \quad (2)$$

where the parameter C is defined in the following equation

$$C = a_1 k + a_2 \tau_a k^* \quad (3)$$

The terms $a_1 k$ and $a_2 \tau_a k^*$ in Eq. (1) must have the same units. Therefore the units of k^* must be Kelvin⁻¹ kg m sec⁻⁴ and the units of constant C are Kelvin⁻¹ kg m sec⁻³.

In the dimensionless Eq. (2) the parameters $x, t, \theta, \varepsilon, e$ are dimensionless whereas the parameters C, τ_0 are dimensional. In a dimensionless equation all terms must be dimensionless. For that reason the Eq. (2) is also wrong and the results in Ezzat and El-Bary (2018) are also wrong.

Reference

Ezzat MA, El-Bary AA (2018) Unified GN model of electro-thermoelasticity theories with fractional order of heat transfer. *Micosyst Technol* 24:4965–4979

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

✉ Asterios Pantokratoras
 apantokr@civil.duth.gr

¹ School of Engineering, Democritus University of Thrace, 67100 Xanthi, Greece