Electro-Thermal Analysis Of A Micro Heater For Aerosol Generation Application

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Abstract

There is an increasing demand for aerosol devices from E-cigarettes to drug delivery devices with precise dosage. [1][2] The aim of this article is to investigate a Poly-Si micro heater in a vapor generator device. In order to calculate the amount of vapor production, temperature distribution, and heat loss calculation of the heater a simulation setup was modeled in COMSOL. The setup consists of a rectangular perforated Poly-Si heater which is placed on a wet fiberglass wick material and powered through gold wire bonds to a PCB. The heater chip is mounted inside the PCB using epoxy glue (Figure 1). The simulation implements coupled electrical current, heat transfer, laminar flow physics and events modules. The electrical current and heat transfer modules are coupled using joule heating Multiphysic. The electrical input power is controlled based on temperature of heater using events interface. There is also Non-isothermal flow Multiphysic which couples heat transfer and laminar flow module to account liquid flow and phase change. All domain is manually meshed using mostly hexahedral and prism elements. The amount of vapor product is about 1 mg after 3 seconds with temperature regulation around 270°C. The heat losses to surrounding air via convection and through wire bonds via conduction are negligible, however most of heat goes to the liquid and epoxy material. The evaporation starts at 0.2 seconds and is almost linearly increasing by time.

Refrences
[1] Pourchez, Jérémie; Oliveira, Fabien de; Perinel-Ragey, Sophie; Basset, Thierry; Vergnon, Jean-Michel; Prévôt, Nathalie (2017): Assessment of new-generation high-power electronic nicotine delivery system as thermal aerosol generation device for inhaled bronchodilators. In International journal of pharmaceutics 518 (1-2), pp. 264-269.
[2] Bhashyam, Abhiram R.; Wolf, Matthew T.; Marcinkowski, Amy L.; Saville, Al; Thomas, Kristina; Carcillo, Joseph A.; Corcoran, Timothy E. (2008): Aerosol delivery through nasal cannulas: an in vitro study. In Journal of aerosol medicine and pulmonary drug delivery 21 (2).

Figures used in the abstract

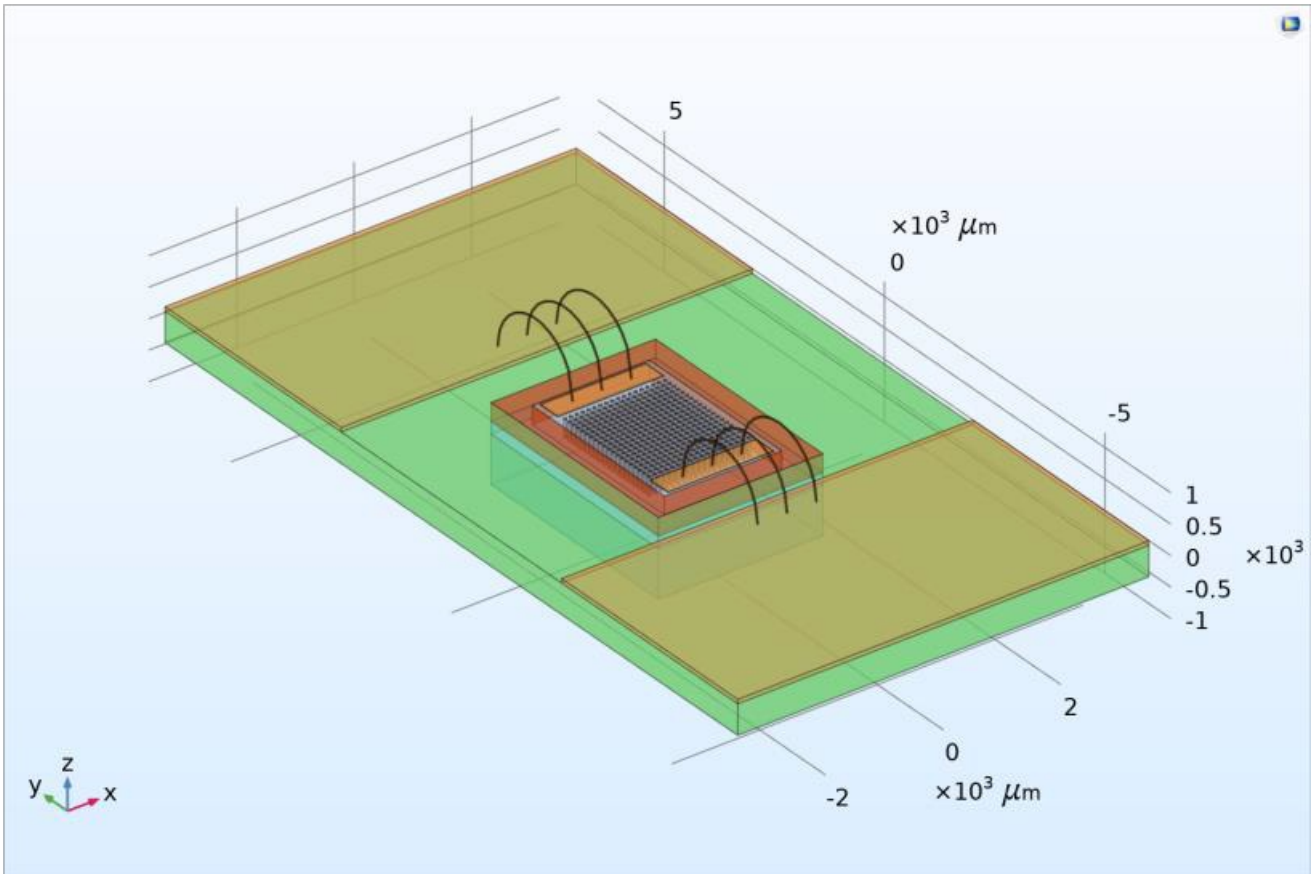

Figure 1 : Heater, PCB, wire bonds and epoxy as simulation domain

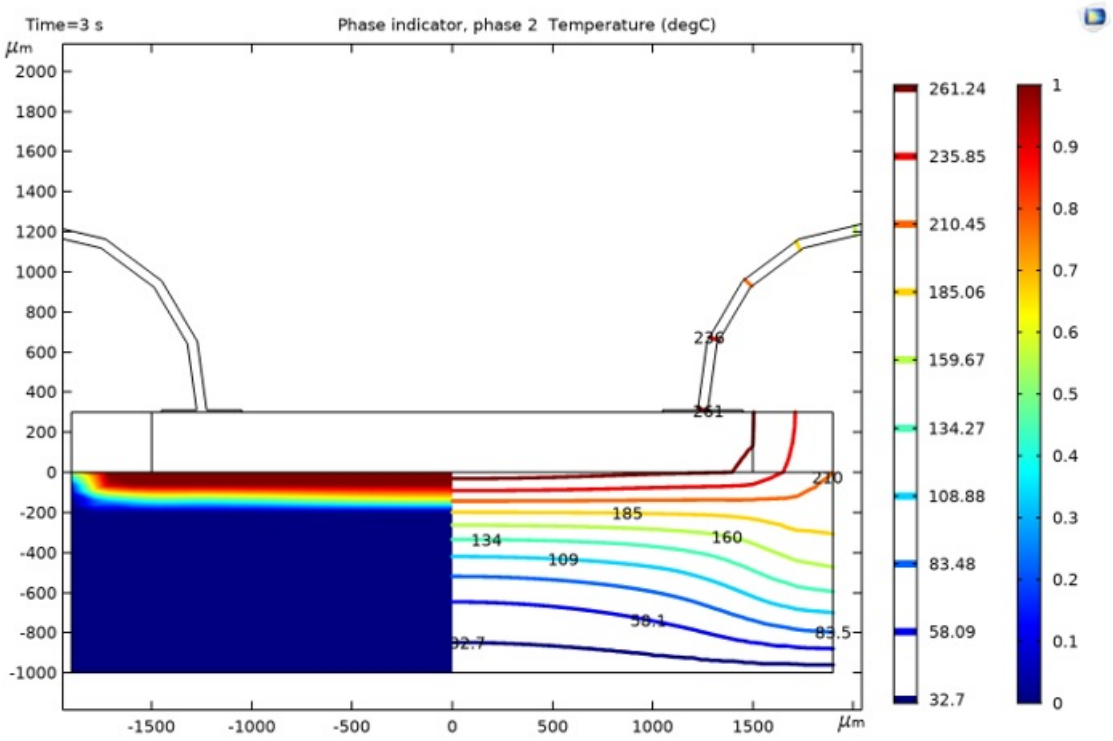

Figure 2 : Liquid temperature and phase indicator, t=3s