Self-consistent Approach to Analysis of Nanostructured-Thermionincs

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There has been a surge of interest in the field of thermionic conversion due to promising features offered by nanomaterials and nanotechnology [1]. The current models, which were initially obtained for macroscopic devices, are incapable of capturing all the aspects of nanostructured devices. We report on a model that calculates the output characteristics of thermionic converters with a higher precision and range of applicability than the existing models. The model is based on coupling the Poisson and the Vlaslov equation and solving for the potential profile. This model can be applied to a wider range of parameters, including temperatures, surface areas, inter-electrode distances and workfunction. More importantly, this methods high numerical precision and flexibility can be used to solve the reverse problem and to obtain the internal parameters of the device from experimental data. As an experimental case, a carbon nanotube forest was used as the emitter of a thermionic converter and heated to thermionic emission temperatures using a low-power focused laser beam. The current-voltage characteristics were measured and used to solve the reverse problem. The values of internal parameters, such as the workfunction of carbon nanotubes and the temperature, were consistent with the values measured through other methods.