

CHAPTER 8

CONCLUSIONS AND FUTURE WORK

'Our imagination is the only limit to what we can hope to have in the future.'

Charles F. Kettering

8.1 Conclusions

In this thesis, we addressed the problem of waste heat in hybrid electric vehicle and its utilization to charge the battery. One of the main contributions of our work is to design and develop a novel waste heat recovery system based on a thermionic emission principle. We have proposed a conceptual design for experimentation and a full scale design using reverse engineering method.

A prototype of thermionic regeneration system (TRS) is designed, simulated, 3D printed and fabricated as a test setup for conducting experiments. Based on that a full scale TRS is designed and simulated. The simulation and experimentation results have shown 14.3% conversion efficiency limited to tungsten and molybdenum. Although the simulation with ultralow work function materials have shown higher conversion efficiencies.

A vehicle model is developed with TRS. Simulation result of vehicle model have shown 6 KW of regeneration. An algorithm to develop a thermionic regeneration control strategy has been derived for use in computer simulations and on-board HEV development. The vehicle model is simulated with 3 Indian Driving cycles. As shown in Figure 7.17, maximum reduction in fuel consumption observed is 23%.

8.2 Future Work

The results from above research have confirmed the feasibility of thermionic conversion method for waste heat recovery. The design is novel and satisfies the requirements of thermionic energy conversion principles. However, the future work must be focused on experimental validation of thermionic regeneration system with on-vehicle testing. The low work function material coatings and non-conventional manufacturing methods must be explored to achieve lower inter electrode spacing and higher conversion efficiencies. The design must be further modified considering its commercial and universal utilization.