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An Intelligent Power Generation from Waste Heat and Avoid Global Warming Effect Using Super Semiconductor

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ABSTRACT:

THE SAVING OF NATURAL RESOURCES, SUCH AS FOSSIL FUEL, IS AN IMPORTANT MISSION FOR THE DEVELOPMENT OF ENERGY TECHNOLOGY. Simultaneously, lowering production costs is a major hurdle in commercializing the new technology and making it competitive with existing ones. The use of thermo electric (TE) power generators to recover energy from electrical, electronic, and mechanical machine exhaust waste heat is particularly promising. Thermal energy in the form of temperature differences is converted into electrical energy by a thermoelectric element, and vice versa. The Seebeck effect is the most fundamental physical phenomenon in thermoelectrics. A TE is the basic building block of a thermal harvester. Using a PELTIER semiconductor (Tiles) module, this system aimed to generate power generation from waste heat. The module is made up of an n-type material connected to a p-type material electronically. Heat begins to flow from the hotter to the cooler side of this material when a temperature differential is introduced across it. When the circuit is closed, the energy from the applied heat causes the free electrons and holes to travel and generate an electric potential, causing current to flow. The temperature differential across the thermoelectric element determines the voltage obtained at the thermal harvester's output. Because the thermoelectric module's output is low, an amplifier is employed to boost the amplitude level of the output voltage to the needed level, which can then be utilized to power loads or charge batteries or other power storage devices. This technology is also focused on preventing the greenhouse effect in the environment.

Keywords:Thermo electric power generators, Seebeck effect, Themal harvestor etc.,

1.INTRODUCTION

The average temperature of the Earth's climate system has been rising throughout time, resulting in global warming. It is a significant part of climate change, as evidenced by direct temperature measurements and measurements of other warming effects. The terms "global warming" and "climate change" are frequently interchanged. Global warming, on the other hand, refers to the primarily human-caused rise in global surface temperatures and its predicted continuation, whereas climate change encompasses both global warming and its repercussions, such as changes in precipitation. While there have been prehistoric episodes of global warming, the velocity and scale of observable changes since the mid-twentieth century have been unprecedented.

A. Existing Method

Temperature changes can impair the accuracy of MOS dosimeter radiation readings, hence a precise temperature characterization of the dosimeter is required. This system shows a temperature control system based on PELTIER modules that allows for automated temperature control of the unit under test (DUT). The system's design and features are given first. The measurements of some of the device's features are shown in the second half. Finally, the controller application is demonstrated by measuring the zero-temperature coefficient (ZTC) of a MOS radiation dosimeter.

Problem Statement

- The temperature measurement process only exists.

B. Proposed Method

Thermal energy is harvested from numerous electrical, electronic, and mechanical running components in this system. This level of energy is in the micro range. This energy was turned into electrical energy that could be utilized to power low-power gadgets. The conversion of heat into electricity (Seebeck effect) or electricity into heat or refrigeration is known as thermoelectricity (TE) (Peltier effect). Using a PELTIER semiconductor (Tiles) module, this system aimed to generate power generation from waste heat. The module is made up of an n-type material connected to a p-type material electronically. Heat begins to flow from the hotter to the cooler side of this material when a temperature differential is introduced across it. When the circuit is closed, the energy from the applied heat causes the free electrons and holes to travel and generate an electric potential, causing current to flow. The temperature differential across the thermoelectric element determines the voltage obtained at the thermal harvester's output. Because the thermoelectric module's output voltage is low, a boost converter is employed to raise it to the needed level, which can then be used to power loads or charge batteries or other power storage devices.

2.LITERATURE REVIEW

Rafael GarcaCozzi (Rafael GarcaCozzi) is [1] Temperature changes can impair the accuracy of MOS dosimeter radiation readings, hence a precise temperature characterization of the dosimeter is required. This system shows a temperature control system based on PELTIER modules that allows for automated temperature control of the unit under test (DUT). The system's design and features are given first. The measurements of some of the device's features are shown in the second half. Finally, the controller application is demonstrated by measuring the zero temperature coefficients (ZTC) of a MOS radiation dosimeter.

AnatoliyTrifonovAleksandrov, IvayloRaychevBelovski, Irina StefanovaAleksandrova [2] Thermoelectric cooling has gotten a lot of attention in recent years. This is owing to the advancement of technology for producing highly effective thermoelectric materials, as well as the numerous benefits of thermoelectric energy converters, such as small dimensions, quiet operation, and environmental safety. The present research shows how to use regression analysis to simulate two temperatures: the cold side heat sink temperature of a thermoelectric pump and the thermoelectric cooling system volume temperature.

Senior Members Matthew Bond and Jae-Do Park [3] A duty-cycle-based maximum power point tracking (MPPT) technique is presented, along with current sensorless power estimation. Traditional MPPT methods necessitate generated power data such as direct current measurement or source and load disconnection for open circuit voltage measurement. While maintaining MPPT capabilities, the suggested technique avoids these drawbacks. This microcontroller-based technique makes it simple to develop and tune the MPPT algorithm to suit the thermoelectric generator's (TEG) properties in relation to environmental circumstances. The hysteresis voltage regulator keeps the TEG output voltage at a set point, allowing the maximum power to be extracted for the given temperature. The suggested MPPT energy harvesting technique is simple and low-cost, consumes little power, and can be employed with a variety of generators. Analytically and empirically, the proposed system has been validated.

II. SYSTEM FUNCTION

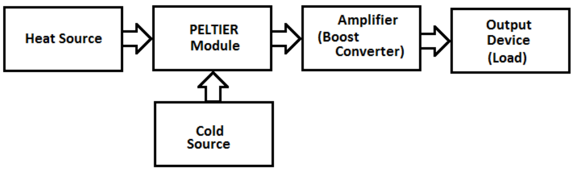

Fig.1 functional block diagram of TE harvesting system

PELTIER, Heat sink, DC motors, Single pole double throw (SPDT) switches, MOSFET amplifier, +5V and +9V power supply unit, LED load, USB charger cable, and mobile phone are all part of the system. The PELTIER is a semiconductor module made up of N-type and P-type components. When heat is supplied to the PELTIER, electrons and holes attract one other. Electricity is produced by the interaction of electrons and holes. The PELTIER produces an electrical voltage of 180 to 240 mV. There is no load driven by the output range. According to the heat input to the PELTIER, the MOSFET amplifier is utilized to increase the voltage of the PELTIER output in the range of 50 to 130V. The amplifier unit's output is used as an input for the +5V and +9V power supply units. The smart or regular mobile phone is charged with the +5V power supply device. The LED light load is powered by a +9V power supply unit. PELTIER out Fig.2 Circuit diagram of TE harvesting system DC motors working in direct PELTIER out DC motors working in direct PELTIER out DC motors working in direct PELTIER out DC motors working in direct PE

Although AC power can be obtained in large quantities using a variety of methods, DC power is essential for many power control circuits and other industrial applications. As a result, AC power must be converted to DC by an electronic rectifier, which is simpler, less expensive, and more efficient than rotary converters or DC generators. The "rectifier" is a circuit that converts pulsing DC voltages and currents from AC voltages and currents. It is made up of DC components as well as undesired ac ripple or harmonic components, which can be removed with the help of a filter circuit. As a result, the output will be a constant DC voltage, with the magnitude of the DC voltage being adjusted by adjusting the magnitude of the AC voltage via a voltage regulator (IC7805 / IC 7809).

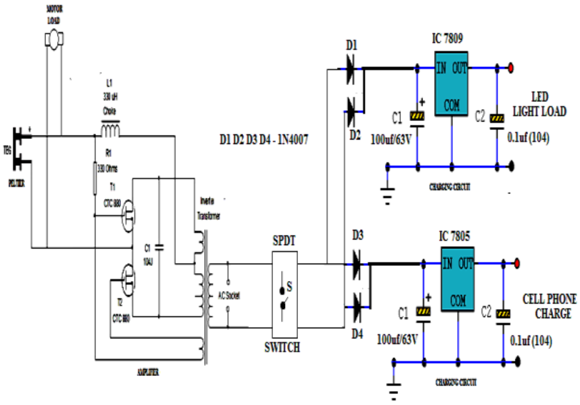

Fig.2 Circuit diagram of TE harvesting system

IV. CONCEPT OF THERMO ELECTRIC ENERGY HARVESTORS

Thermal energy in the form of temperature or cooling differences is converted into electrical energy by a thermoelectric device, and vice versa. The Seebeck effect is the most fundamental physical phenomenon in thermoelectrics. A thermocouple is the most basic component of a thermal harvester. The thermocouple is made up of an n-type material connected to a p-type material electronically. Heat begins to flow from the hotter to the cooler side of this material when a temperature differential is introduced across it. When the circuit is closed, the energy from the applied heat causes the free electrons and holes to travel and generate an electric potential, causing current to flow. The open-circuit voltage can be calculated using the formula, where S is the thermopile's Seebeck coefficient and is the temperature difference applied across the harvester. The metal linkages and the resistance along the pellets are the sources of resistance. This set of p- and n-legs provides roughly 25 mV/K of temperature differential applied across the harvester for a 10 cm device. Because of the tiny temperature differential (2–3 K) available, this poses a severe difficulty when using thermoelectric harvesters for body-worn devices powered by human heat. The open-circuit voltage of the thermal harvester is only 50–75 mV. In the absence of a battery, this voltage cannot be used to directly power CMOS circuitry.

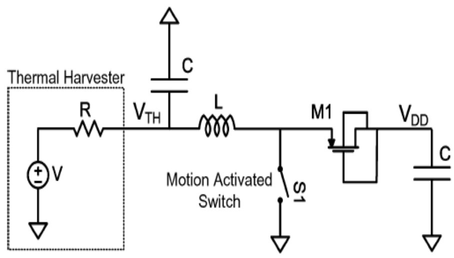

Fig: 3 A mechanically assisted startup circuit to kick start electrical energy extraction from the TEG.

The mechanical switch S1 depicted in the diagram turns on and off when a very small quantity of vibration of less than 0.1 g in acceleration is applied. When the device is worn on a person's arm or body, vibrations can be generated. The voltage accessible from the thermoelectric harvester causes current to flow in the inductor L when the switch S1 is turned on. The current in the inductor must find a new path to flow when the switch is turned off. The energy flows into the capacitor CDD as the transistor M1, which is connected as a diode, turns on. The voltage obtained at CDD at the end of the ON/OFF cycle if the diode is deemed perfect and there was no initial voltage across CDD is

$$V_C(final) = \frac{\sqrt{L/C_{DD}}}{R_T + R_L + R_{SW}} V_T = Q_T V_T$$

Where Q_T is the startup network's Q-factor, RT is the thermoelectric harvester's internal resistance, and RL and RSW are the inductor's and switch's parasitic series resistances, respectively. This may be calculated by equating the energy stored in the inductor when switch S1 is turned on to the energy stored in the capacitor when the inductor current is zero.

With a QT of 42 and a VD of 0.6 V, the input open circuit voltage must be at least 35 mV to get a 1 V output. The value of L is 22 m, while the value of is 470 pF. The parasitic resistances add up to 150 m, while the thermal harvester has a resistance of 5 m. This results in a QT of 42. By increasing L or decreasing CDD, the voltage gain can be enhanced. Excessively increasing L raises the system's size and expense. CDD, on the other hand, cannot be reduced arbitrarily because circuits require a considerable amount of energy to function. Reducing VD also helps to reduce the necessary input voltage for startup. This, however, is depending on the process. Due to a lack of adequate voltage to turn on the switches, synchronous rectifiers are not possible during startup. A temperature difference of 1.5 K across the thermoelectric harvester may be reached with 35 mV of open-circuit voltage, which can be attained in body-worn applications.

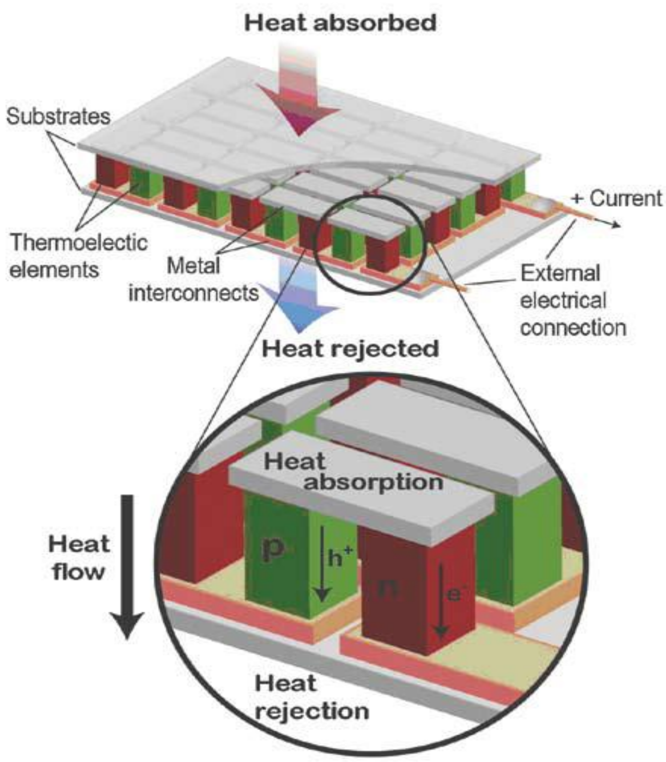

Fig:4 powers driven of PELTIER

A thermoelectric generator efficiently converts heat (Q) into electrical power (P). (1) The quantity of heat, Q, that may be channeled via thermoelectric materials is typically determined by the size of the heat exchangers used to harvest and reject heat on the hot and cold sides, respectively. Because heat exchangers are often much larger than thermoelectric generators, when space is limited (or a high P/V is sought), designing for maximum power may take precedence over designing for optimum efficiency. The temperature difference (and thus thermoelectric efficiency, as described below) between the heat source and sink may be only half that in this case. 3 The temperature difference T = Th – Tc across the device has a significant impact on the efficiency of a thermoelectric converter. This is because, like all heat engines, the thermoelectric generator cannot have a higher efficiency than a Carnot cycle (T/ Th).

$$h = \frac{\Delta T}{T_h} \cdot \frac{\sqrt{1+ZT}-1}{\sqrt{1+ZT}+T_c/T_h}$$

Where the first term is the Carnot efficiency and ZT is the figure of merit for the device. While the calculation of a thermoelectric generator efficiency can be complex,4 use of the average material figure of merit, zT, can provide an approximation for zT..

$$zT = \frac{\alpha^2 T}{\rho\kappa}$$

Here, Seebeck coefficient (α), electrical resistivity (ρ), and thermal conductivity (κ) are temperature (T) dependent materials properties. Recently, the field of thermoelectric materials is rapidly growing with the discovery of complex, high-efficiency materials. A diverse array of new approaches, from complexity within the unit cell to nano structured bulk, nano wire and thin film materials, have all lead to high efficiency materials.

CONCLUSION

The conversion of heat into electricity (Seebeck effect) or electricity into heat or refrigeration is known as thermoelectricity (TE) (Peltier effect). The Seebeck effect may enable heat to be conserved that would otherwise be lost. Although the conversion efficiency is modest, it has been rediscovered in recent years, and new research and development avenues, such as new materials and nanoscale matter structure, have been explored. This combination has sparked intense research around the world, but without the crucial breakthrough that will elevate TE to the forefront of energy collecting technologies. Thermal engine heat recovery (especially in transportation applications) and human body heat scavenging to power portable gadgets are the most promising applications of TE in terms of energy savings. Low conversion efficiency, toxicity, and low availability of chemical components composing part of the most interesting thermoelectric materials are all obstacles to overcome when using TE for energy harvesting. The key hurdles for nanotechnology in this context are to demonstrate.

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