# CHARACTERISTICS OF EDGE ILLUMINATED PHOTOVOLTAIC DEVICES

By

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# ABSTRACT

Electricity is a privilege that the majority of people take for granted. From every day household items such as computers, televisions, refrigerators, and ovens, to military necessities such as radar facilities, and missile silos, people hardly ever stop to think about what life would be like without these items. Just as we rely on these items for every day life, these items rely on electricity to function. It has been determined that if fossil fuels are continuously burnt at the rate they are today, the supply will be drastically diminished within one hundred years. If an alternate method of electricity generation is not created, the increase in fuel prices, due to oil and gas companies trying to compensate for loss, will be astronomical. Economic recessions could result during such a tragedy not to mention massive riots or even large scale wars. However, even though these disastrous events may not occur, it is important to take the proper steps today in order to ensure a smooth transfer from fossil fuels to a renewable energy source.

It is the feeling of many that the key to developing a reliable and renewable energy source lies with the sun. In fact, it has already been proven that if, one day, we could harness all the energy the sun provides, there will never be a need for fossil fuels. It is this understanding that sparked the interest for the research presented in this thesis. Unfortunately, current technology does not allow us to capture all the energy provided to us by the sun. It turns out that, on our best day, we cannot even capture half of this power, about 41 percent, not to mention how expensive this technology is. This type of research will always move in steps. Increasing the amount of power generated is always important, but without this technology being affordable, it is practically useless. It is therefore the focus of this research to utilize low cost solar power devices and design new systems that could improve their overall output power. If this can be achieved then the dream of designing an affordable and efficient renewable energy source will be that much closer to reality.

Within the framework of the current research, the power generated by illuminating existing photovoltaic (PV) devices from the edge of the p-n junctions as

opposed to traditional surface (top) illumination was evaluated. A variety of geometries for enhancing light coupling from the light source to the thin edge of the semiconductor devices were studied. It has been observed that by simply coupling light more efficiently to existing commercial PV devices, the electrical power output increased by 25 fold compared to surface illumination (as in existing solar panels on the roof tops). Future research in this area includes light coupling via high transmission optical fibers. We also propose to evaluate the concept of thermo-photovoltaic (TPV) power generation using solar concentrators in conjunction with intermediate blackbody radiators such as silicon carbide films deposited on silicon PV cells. The latter is expected to tremendously enhance the power conversion efficiencies of the solar to electricity.