INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT (IJSREM)
VOLUME: 04 ISSUE: 09 | SEPT -2020 ISSN: 2582-3930

INCREASING THE THERMAL CONDUCTIVITY OF SOLAR PANNEL BY USING ALUMINIUM NITRIDE

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Abstract: NUST MISIS scientists together with their colleagues from the Central Metallurgical R&D Institute (Cairo, Egypt) have developed a composite material to extend the life of solar towers up to five years. The research article has been published in Renewable Energy. Today, solar power plants (SPP) are becoming increasingly popular, making it possible to collect and process solar energy on an industrial scale. So called solar towers are among the most promising types of SPPs. An SPP is a high tower with a water tank and a turbine system inside. The tower is surrounded by heliostats—large spinning mirrors that absorb the sun's rays and concentrate the total beam at a single point on the tower. The beam lands on the solar absorber, which heats a special salt solution up to 600°C. The water in the adjacent tank is heated from the salt solution and the steam rotates the turbines of the power plant. Silicon carbide (SiC), a porous ceramic material with a number of useful characteristics—high density, strength, and resistance to oxidation among other things—is the traditional element for solar absorbers. However, silicon carbide has disadvantages—for example, it is sensitive to the aggressive environment of salt melts .Aluminum nitride (AIN) is a promising addition to silicon carbide—it has high thermal conductivity, a low coefficient of thermal expansion, and high temperature resistance. Currently, Sic and AIN composites are mainly used in electronics, but they can potentially be used in a number of other fields, including the thermal transformation of solar energy

Key words: Aluminum nitride, Thermal conductivity, Silicon Carbide & Solar Energy

I.INTRODUCTION

Aluminium nitride (AlN) is a solid nitride of aluminium. It has a high thermal conductivity of up to 285 W/(m·K), and is an electrical insulator. Its quartzite phase (W-AlN) has a band gap of ~6 eV at room temperature and has a potential application in optoelectronics operating at deep ultra violet frequencies

AlN was first synthesized in 1877.AlN, in the pure (undoped) state has an electrical conductivity of 10−11-10−13 Ω−1·cm−1, rising to10−5-10−6 Ω−1·cm−1 when doped. Electrical breakdown occurs at a field of 1.2–1.8×105 V/mm (dielectric strength). It is predicted that the cubic zinc blend phase of AlN (Zb-AlN) can

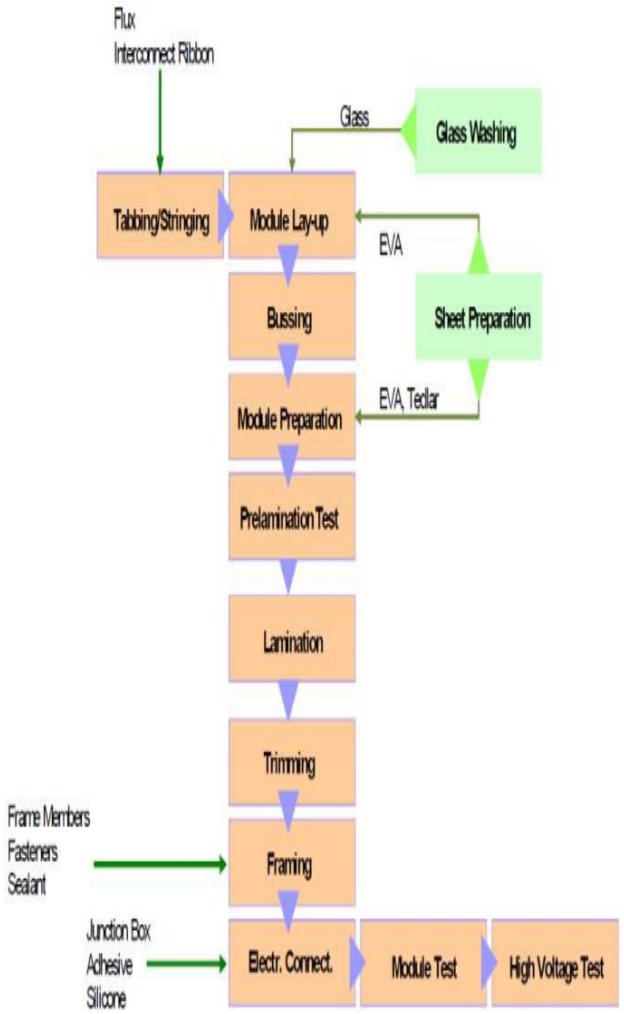
Exhibit superconductivity athigh pressures.[9]AlN has high thermal conductivity, especially for an electrically insulating ceramic (70–210 W/(m·K) for polycrystalline material, and as high as 285 W/(m·K) for single crystals). It possesses tremendously elevated temperature stability. Low cost of material compared to traditional metallic materials. It has excellent corrosion resistance .At high range of operating temperatures it possesses greater fouling resistance and chemical erosion.

Type of solar Panel Materials and their thermal Conductivity.

- Crystalline Silicon (c-Si) 2.8W/cm-K
- Amorphous Silicon (a-Si) 1.8W/m-K
- Gallium Arsenide(GASA) 52 W/m-K(at 300K)
- Organomettalics (Soluble Platinum) 11.2 ± 0.8 W m^{-1} K^{-1}(At Room Temperature).

II. METHODOLOGY

Here we are showing simple concept of manufacturing process of solar panel



III. ALUMINIUM NITRIDE EXTRACTION:

Aluminum nitrate cannot be synthesized by the reaction of aluminium with concentrated nitric acid, as the aluminium forms a passivation layer. Aluminium nitrate may instead be prepared by the reaction of nitric acid with aluminium chloride. Nitrosyl chloride is produced as a by-product; it bubbles out of the solution as a gas. More conveniently, the salt can be made by reacting nitric acid with aluminium hydroxide.

Aluminium nitride may also be prepared a metathesis reaction between aluminium sulfate and a nitrate salt with a suitable cation such as barium, strontium, calcium, silver, or lead.

$$Al(NO3)3 + 3\ NaOH \rightarrow Al(OH)3 + 3\ NaNO3$$

The nonohydrate and other hydrated aluminium nitrates have many applications. These salts are used to produce alumina for preparation of insulating papers, in cathode ray tube heating elements, and on transformer core laminates. The hydrated salts are also used for the extraction of actinide elements.

IV. EXPERIMENTAL SETUP.

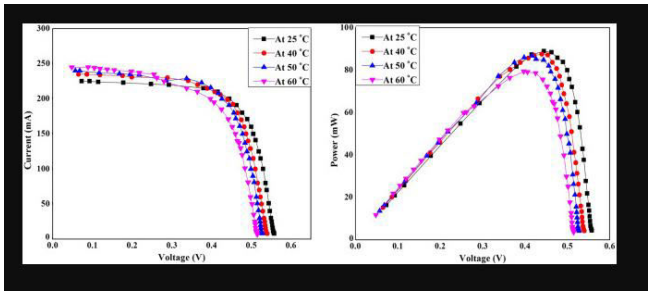
A mono-crystalline aluminium nitride solar cell of (4×4) cm2 area was used and the experiment was undertaken employing solar cell simulator with cell temperature in the range 25-60 °C at constant light intensities 215–515 W/m2 of simulated two quartz Halogen lamps (OSRAM 50 W, 230 V each). The light intensity or irradiance of Halogen lamps was measured by solar power meter. To reduce the intensity of these lamps, various types of glass plates and a number of gray filters were introduced between assembly of lamps and lower chamber of the solar cell simulator. The light intensity of Halogen lamps with different glass plates and filters is

illustrated in Table 1. The frosted glass plate helps to diffuse the light and to make it uniform especially if perforated metal plates are used as light attenuators to reduce the light intensity. An exhaust fan was used to cool the solar cell simulator during the entire period of acquisition of the experiment and a temperature control unit was also used to vary the cell temperature. The temperature control unit comprises a heater and temperature sensor to stabilize the required temperature of mc-Si solar cell and it controls the temperature from room temperature to 80 °C. The mc-Si solar cell was used as a power source, current–voltage and power–voltage characteristics were taken into account
and photovoltaic parameters were calculated. The relative changes in photovoltaic parameters with cell temperature were also calculated.

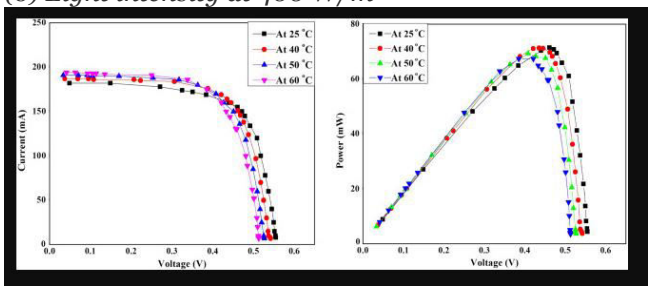
V.RESULTS AND DISCUSSION

The current–voltage and power–voltage characteristics of Aluminium Nitride solar cell with cell temperature at constant light intensity are presented in Fig. 1. The observations were undertaken for cell temperatures 25 °, 40 °, 50 ° and 60 °C at the constant light intensities 215, 280, 400 and 515 W/m2.

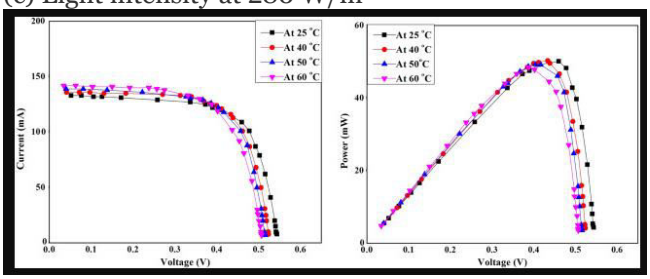
(a) Light intensity at 515 W/m².



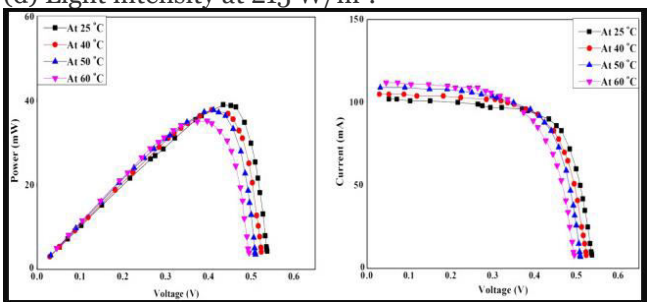
(b) Light intensity at 400 W/m²



(c) Light intensity at 280 W/m²



(d) Light intensity at 215 W/m².



VI. LAB RESULT.

Aluminum nitride (AIN) is a promising addition to silicon carbide—it has high thermal conductivity, a low coefficient of thermal expansion, and high temperature resistance. Currently, Sic and AIN composites are mainly used in electronics, but they can potentially be used in a number of other fields, including the thermal transformation of solar energy. Find the attachment as pdf for Lab Results.

VII. CONCLUSION:

The results obtained from the aluminium nitride solar panel with various temperature checking at 20 ° C-60°C with the result of lab approval we can conclude that solar panel will work at any temperature

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