Advancing Heat Transfer Efficiency in Solid-State Lighting

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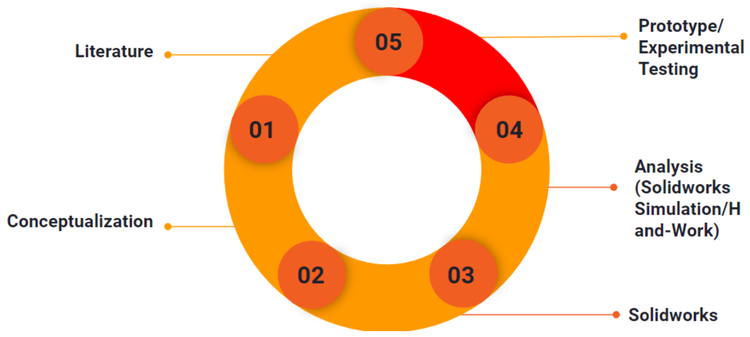
Problem

- Research, design, simulate, experimentally test, and develop a working LED heat sink prototype that, at the very least, significantly decreases the maximum temperature of the current base model sample provided by U Technology.

Goal

- The purpose of having a greater heat transfer efficiency is to increase the LED's working lifetime and enhance durability; performance; and scalability for future models.

Design Process

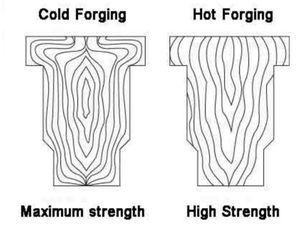


Material: 1070 Aluminum

- Thermal conductivity: 236 W/(mK)
- Price: $2.70 per sheet
- Prototype friendly material: 6061 Aluminum Alloy

Manufacturing Process

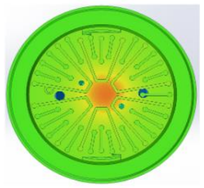
- Optimal process is cold forging.
- Prototype friendly process: Computer Numerical Control (CNC) machining



Initial Simulations

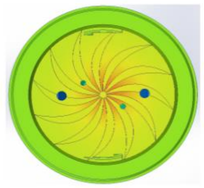
Current Design

Max Temperature: 79.7°
Min Temperature: 38.6°
Mass: 222.02g
Surface Area: 687.8cm²



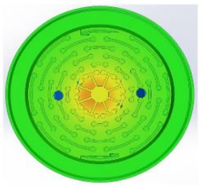
Spiral Design

Max Temperature: 88.4°
Min Temperature: 39.9°
Mass: 231.84g(+4.4%)
Surface Area: 489.2cm²



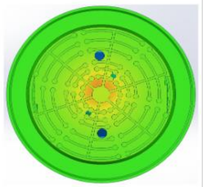
Smiles Design

Max Temperature: 81°
Min Temperature: 38.7°
Mass: 225.39g(+1.5%)
Surface Area: 711.6cm²

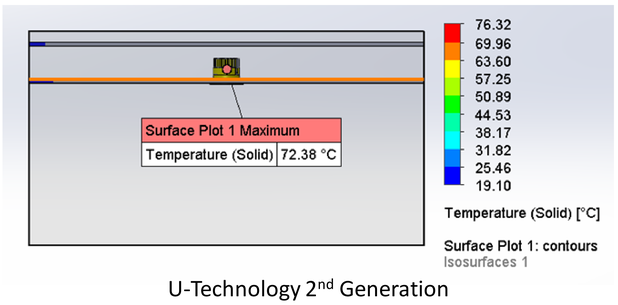


Snowflake Design

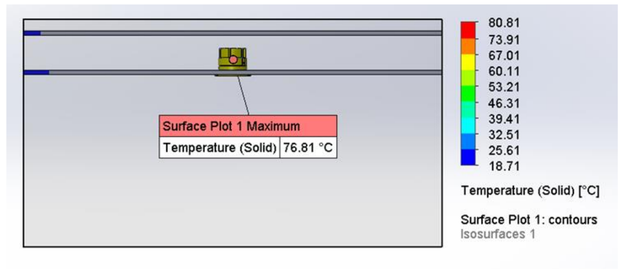
Max Temperature: 76.3°
Min Temperature: 38°
Mass: 234.15g(+5%)
Surface Area: 764.8cm²



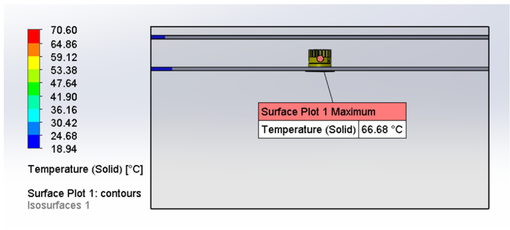
CFD Results



U-Technology 2nd Generation



Snowflake Design



Spiral Design

References

1. T. L. Bergman and A. S. Lavine, Fundmentals of Heat and Mass Transfer, John Wiley & Sons, Inc, 2017.
2. M. A. Hussein, V. M. Hameed and H. T. Dhaiban, "An Implementation study on a heat sink with different fin configurations under natural convective conditions," ScienceDirect, 2022.
3. For complete list of references, contact any group member.

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