Thermal Diffusivity of Metal Powders for Use in Additive Manufacturing

Mason Seldes, Mechanical Engineering
Mentor: Dr. Leila Ladani
School for Engineering of Matter, Transport, and Energy

Abstract

Laser Flash Analysis (LFA) is a method used to measure the thermal diffusivity of a material. This method, first developed by Parker et al. in 1961, involves sending an energy pulse to one side of a sample while recording the time-dependent temperature response on the opposite side. The resulting thermogram allows thermal diffusivity to be inferred rather than directly measured. This work focuses on understanding and applying laser flash method models, including Parker's, Lee's, and corrections for non-ideal conditions are explored to accurately determine thermal properties. These methods are critical for characterizing materials used in advanced manufacturing processes, particularly in layered and powder-based systems.

Purpose

The purpose of this research is to determine the thermal diffusivity of metallic and composite materials using laser flash analysis.
This includes:

- Understanding fundamental laser flash principles
- Applying analytical models for homogeneous and layered systems
- Accounting for non-ideal effects such as heat loss and finite pulse duration
- Analysis of powder and complex material systems

FIG 1: LASER FLASH APARATUS

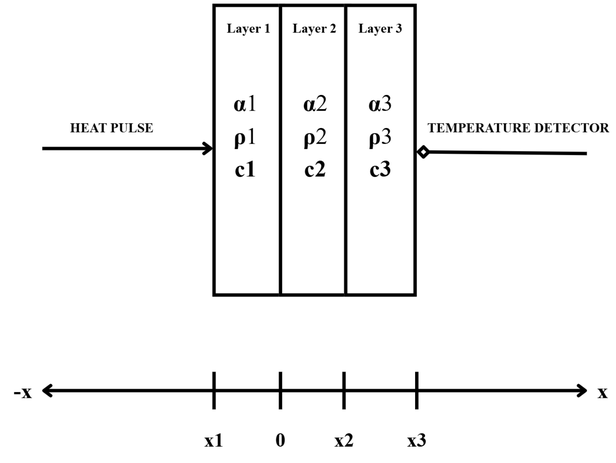
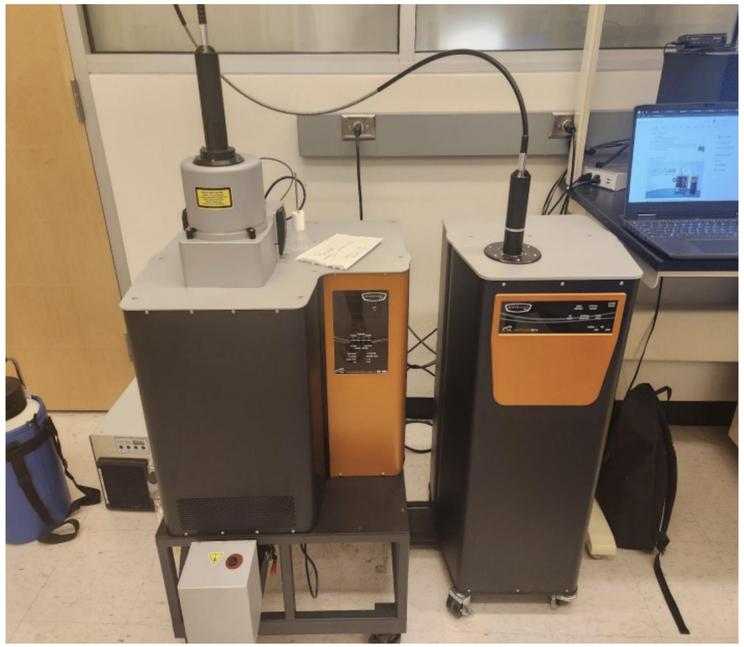


FIG 2: DLF 1600



Method / Approach

- Use Laser Flash Apparatus (LFA) to generate thermograms
- Analyze homogeneous samples using Parker's model
- Apply Lee's model for layered materials
- Implement corrections for heat loss and pulse duration
- Use numerical modeling for complex systems
- Compare experimental and simulated temperature responses

Next Steps

Complete laser flash testing of Titanium, Inconel, Stainless Steel 316L, and more powders.
Analyze and compare thermograms using different models.

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Ira A. Fulton Schools of Engineering
Arizona State University