DEPARTMENT OF MECHANICAL AND MATERIALS ENGINEERING
COLLEGE OF ENGINEERING AND APPLIED SCIENCE

RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

APPLICATION DEADLINE: 12/15/2023

PROJECT TITLE: Laser Shock Peening for Fatigue Life Improvement of Titanium Alloys in Aeroengines

Physical Requirement : None.
Project's Technical Skills Requirement : N/A; on-the-job training will be provided
Project's Available Positions : 1

Eric J. Payton, PhD
Department of Mechanical and Materials Engineering
627 Rhodes Hall
Cincinnati, OH 45221
paytonej@ucmail.uc.edu
Phone: 513-556-0260

Matthew A. Steiner, PhD
Department of Mechanical and Materials Engineering
637 Rhodes Hall
Cincinnati, OH 45221
Tel: (513) 556-8051

Project Description

Aerospace components must withstand high loading for thousands of flight cycles. They are held to very high quality standards, and aeroengine companies continuously look for ways to improve the longevity and efficiency of their products. Preventing crack formation and propagation is a key aspect of extending the useful life of aerospace components.

This project will involve working closely with an industrial partner to understand how laser shock peening can be used to improve the fatigue life of titanium alloys (such as Ti-6Al-4V). Laser shock peening is a surface treatment process that uses a pulsed laser to send a shock wave into the surface of a material, resulting in a compressive stress at the surface. This surface treatment improves the resilience of the material to surface crack initiation, extending its useful life under fatigue loading.

This project will be an excellent launchpad for students interested in research careers in materials performance for aerospace applications. You will collaborate with the research department of a leading aeroengine manufacturer while working in the Critical Alloy Research & Discovery (CARD) Lab in the Department of Mechanical and Materials Engineering. We are a dynamic and interactive team enthusiastic about advancing sustainability and extending the durability of critical alloys for transportation, energy, and security.

Preferred skills include:
• Proficiency in PowerPoint and Word to document observations for weekly
meetings
• Proficiency in Excel to calculate and plot measurements
• Familiarity with Python, Matlab, and LabVIEW

Training provided:
• Use of laser shock peening system
• Introduction to titanium metallurgy
• Metallographic specimen handling and preparation
• Optical microscopy
• Surface residual stress characterization using X-ray diffraction
• Resonant ultrasound spectroscopy
• Laser confocal microscopy