Announcing the Final Examination of Linda Rossmann for the degree of Master of Science

Time & Location: July 3, 2019 at 1:00 PM in Engineering 2 (ENG2) 202A
Title: Analysis of residual stress and damage mechanisms of thermal barrier coatings deposited via PS-PVD and EB-PVD

Thermal barrier coatings (TBCs) protect components in gas turbine engines from the extreme operating temperatures. The industry standard deposition method for jet engine turbine blades is electron-beam physical vapor deposition (EBâ€"PVD). An emerging method is plasma-spray physical vapor deposition (PSâ€"PVD), capable of producing customizable microstructures and coating more complex geometries and is a possible alternative to EBâ€"PVD. Before PSâ€"PVD can be used to its full potential, the resulting mechanical properties and behavior must be understood. This work characterizes PSâ€"PVD TBCs that have been thermally cycled to simulate multiple lifetimes. Residual stress in the thermally grown oxide (TGO) and topcoat are characterized by spectroscopy; these stresses drive cracking that leads to failure. Microstructural evolution is observed by scanning electron microscopy. EBâ€"PVD samples are also characterized to benchmark PSâ€"PVD against the industry standard. The compressive residual TGO stress in both coatings was relieved with thermal cycling due to TGO lengthening and microcracking. The PSâ€"PVD samples had lower TGO stress than EBâ€"PVD, attributed to more extensive cracking within the TGO; EBâ€"PVD samples cracked along the TGO/topcoat interface. The PSâ€"PVD cycled samples had more cracking within the topcoat due to greater porosity. The TGO stress results agree with literature and extend the thermal cycling beyond what has been reported for PSâ€"PVD coatings, revealing stresses like those of EBâ€"PVD. Residual stress in the topcoat for both coating types became increasingly compressive with cycling, indicating loss of strain tolerance by sintering. The YSZ stress trends for both coating types agree with the literature, and the thermal cycling is longer than has been reported for PSâ€"PVD. The two coating types had different microstructures, crack modes, and as-deposited residual stresses, but after thermal cycling had similar stresses in both TGO and topcoat. These results indicate that PSâ€"PVD coatings can be a viable alternative to EBâ€"PVD.

Major: Materials Science and Engineering

Educational Career:
Bachelor's of Mechanical Engineering, BS, 2017, University of Central Florida
Bachelor's of Fine Arts, BA, 2012, University of Florida

Committee in Charge:
Seetha Raghavan, Chair, Mechanical & Aerospace Engineering
Ranajay Ghosh, Mechanical & Aerospace Engineering
Yongho Sohn, Materials Science & Engineering
Raj Vaidyanathan, Materials Science & Engineering

Approved for distribution by Seetha Raghavan, Committee Chair, on June 14, 2019.

The public is welcome to attend.