An Investigation of Phase Crystallinity in Laser Modified Yttria Stabilized Zirconia (YSZ) Thermal Barrier Coating

Mohamed Suffian Reza[a], Syarifah Nur Aqida[ab], Mohd Radzi Mohd Toff[c]

[a] Faculty of Mechanical Engineering, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia

[b] Automotive Engineering Centre, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia

[c] Advanced Materials Research Centre, Sirim Berhad, Lot 34, Jalan Hi-Tech 2/3, Kulim Hi-Tech Part, 09000 Kulim, Kedah Malaysia

ABSTRACT

This paper presents laser surface modification process of plasma sprayed yttria stabilized zirconia (YSZ) thermal barrier coating (TBC) for enhanced hardness properties and low surface roughness. A 300W JK300HPS Nd: YAG laser was used to process YSZ TBC sample surface. The parameters selected for examination were laser power, pulse repetition frequency (PRF) and residence time. Micrographs of the TBC system were captured using EVO 15 Scanning Electron Microscope (SEM). Surface roughness was measured using 2-dimensional stylus profilometer. X-ray diffraction analysis (XRD) was conducted to measure phase crystallinity of the laser-modified coating surface. X-ray diffraction patterns were recorded in the 2θ range of 10 to 80° using Bruker D8 Advance system with 0.7Å wavelength from a copper source (~1.5Å). The laser modified surface exhibited higher crystallinity compared to the as-sprayed samples. The presence of tetragonal phase was detected in the assprayed
and laser processed samples. The hardness properties of laser modified TBC increased 15% of the as-sprayed sample. These finding are significant to development of thermal barrier coating design optimization for enhanced surface properties of semi-solid forming die.

KEYWORDS: Laser Surface Modification; Phase Transformation; Thermal Barrier Coating (TBC); Yttria Stabilized Zirconia (YSZ)

DOI: 10.4028/www.scientific.net/KEM.611-612.1601