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Evaluation of Gasoline Engine Piston with Various Coating Materials Using Finite Element Method

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Abstract : The purpose of this paper is to examine the piston stress distribution using several thicknesses of the coating materials to achieve higher gasoline engine performance. First of all, finite element structure analysis is used to uncoated petrol piston made of aluminum alloy. Then, steel and cast-iron piston materials are conducted and compared with the aluminum piston. After that, investigation of four coating materials namely, yttria-stabilized zirconia, magnesia-stabilized zirconia, alumina, and mullite are studied for each piston materials. Next, influence of various thickness coating layers on the structure stresses of the top surfaces is examined. Comparison between simulated results for aluminum, steel, and cast-iron materials is reported. Moreover, the influences of different coating thickness on the Von Mises stresses of four coating materials are investigated. From the simulation results, it can report that the maximum Von Mises stresses and deformations for the piston materials are decreasing with increasing the coating thickness for magnesia-stabilized zirconia, yttria-stabilized zirconia, mullite and alumina coated materials.

Keywords : structure analysis, aluminum piston, $MgZrO_3$, YTZ, mullite and alumina
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