Prediction of Temperature and Thermal Stress in Plasma Sprayed Coatings

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Abstract

Plasma spraying is one of the prominent technologies for wear, corrosion and high temperature resistant coatings. The coating quality is very important to increase the performance of the components as well as to protect the outer surface of the component from external environment. The coating quality characteristics depend on many plasma process parameters. Among these parameters, distribution of temperatures and stress in substrate/coating having considerable effect on properties of plasma sprayed coating. Hence, it is necessary to study the mechanisms of stress development to predict and control the temperature and stresses.

1-D model is developed using COMSOL Multiphysics® software to predict the thermal history and stress distribution of substrate/coating during plasma spraying. The mathematical model includes plasma and particle heat flux as well as temperature dependent thermo-physical properties to predict the temperature distribution of substrate/coating by considering semi-infinite body approximation. The effect of coating thickness and stand-off distance are taken into account for simulation.

From this study, it is expected that temperature and stress distribution of substrate/coating as well as the effect of coating thickness and stand-off distance on coating temperature can be predicted. Finally, the mathematical model will help to understand the mechanism of stress development within coating as well as to control the plasma process parameter to obtain good and required coating properties for suitable application in economical and effective manner.

Reference

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