

Preface

Defect sites can be created in solid substrates when subjected to a deformation or a thermal distortion and the property variation occurs in defected regions, such as elastic module, density, Poisson's ratio variations in the heat affected zone of the welded, or locally heat treated sites in the solid substrates. In addition, during thermal processing, the properties of the substrate material change because of the temperature dependence. Flexural motion of the substrate material, subjected to thermal processing, provides useful information about the level distortion in the substrate material, which is more pronounced as the temperature in the substrate material increases. However, nonlinear response of the elastic modulus, due to the temperature filed, changes amplitude and time shift of amplitudes due to residual thermal distortions. Determining magnitude and phase lagging of the maximum amplitude provides information about the heating rate, heat source speed, size of heat affected zone, etc. Therefore, flexural characteristics of the substrate material can be associated with the source of distortion, which in turn enables to control the process for improved performance and the end product quality. Nondestructive testing of coat layer thickness is very fruitful to assess characteristics of thermal spray coating process. Monitoring the flexural motion enables to correlate amplitude and frequency of the wave with geometric configuration of coating, such as coating thickness, coating uniformity, tapering, etc.

High velocity oxy-fuel (HVOF) spraying technique finds wide application in industry because of low cost and operational easiness. Although HVOF coating protects the substrate surfaces from high temperature and wear environments, presence of porous and oxide inclusions in the coating reduces mechanical strength of the resulting coating. Thermal integration of coating is possible by introducing control melting using high energy beams, in which case, pores and voids can be eliminated in the coating. Mechanical, metallurgical, and morphological characteristics of coating are highly affected by melting rates and cooling periods of the coating. In thermal processing, such as welding, property changes in the welded regions are important to secure sound and quality welds for the practical applications. Optimization of welding process, utilizing flexural characteristics of the welded material improves mechanical and metallurgical properties and assists to produce desirable welds for the particular applications.

In this book, thermal analysis and flexural motion of weld joints and thermally processed parts are presented. Analytical and numerical simulations of flexural

characteristics of cantilever beams are provided in detail. Several heating situations and flexural behavior of the thermally treated beams are included. Various studies for high velocity oxy-fuel coating are introduced and coating characteristics prior and after controlled melting by a laser beam are discussed. Changes in metallurgical, mechanical, and morphological characteristics of coating are described for various types of coating powders. However, some cases related to modeling of flexural characteristics and coating properties are not presented in this book due to space limitations and, therefore, these cases are left for the future treatments.



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Characteristics

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