EDDY-CURRENT NDE OF COMBUSTION TURBINE BLADE COATINGS. DETERMINATION OF CONDUCTIVITY PROFILES IN PRESENCE OF DIFFUSION PROCESS

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Abstract

In the view of optimizing the maintenance cost of combustion turbine, it is necessary to predict remaining blade coating life. This goal can be achieved by using a multi-frequency Eddy Current non-destructive technique for assessing condition and quality of the coatings and hence permitting reduction of unexpected shut-downs caused by blade coating failure. This paper deals with stating and solving underlying direct and inverse problems.

The direct problem consists in modelling the impedance coil over a layered metallic structure protected by a top over-aluminized coating who degrades by inward and outward diffusion of aluminium, respectively due to differences of conductivities between the coating and blade materials and to oxidation when aluminium in the coating diffuses out to reform the protective oxide layer formed by metallic coatings which spalls off during operation. For taking such diffusion process of aluminium inside the blade into account, we developped a model where the conductivity profile, which varies continuously with depth in the blade, is described using two hyperbolic tangents (we extend the Uzal-Rose's model [1] based on one hyperbolic tangent conductivity profile). Comparison of results obtained with this model and with those obtained with a numerical multi-layers model, based on discretization of the conductivy profile by a high number of layers of constant conductivity, is very good.

The inverse problem consists in estimating conductivity profile by minimizing an error function defined as euclidian norm of difference between Eddy-Current measurements over blade coating and output of the direct model describing the predicted impedance coil for a given layered structure [3]. We explicit expressions of derivatives of impedance coil with respect to parameters model needed for optimizing the error which is sought using a conjugate gradient algorithm. We illustrate the talk by typical results.

References

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