

Computational modelling of plasma electrolytic oxidation process induced damage in extruded Mg material

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Mechanical damage induced failure within protective coatings is one of the main reasons for loss of coating functionality. Thus, for applicability of any coating technology it is mandatory to know how the protective barrier effect will change during component deformation and which physical entities drive damage initiation and propagation. Within this work a computational model has been developed which allows to correlate and to study the effect of coating parameters on the stress-strain curve shape of plasma electrolytic oxidation (PEO) process based coated Mg substrates. This is a great benefit as deriving materials laws is very difficult since measured stress-strain relationships are a convolution of substrate material and coating material contribution. The approach is based on a damage model which allows to distinguish between the substrate contribution model as a bulk body described by dedicated materials law and the brittle coating contribution modelled as a ceramic shell of defined thickness and morphology. The effect of coating thickness, steady state crack spacing and coating porosity on the entire stress-strain curve is shown. The approach might allow direct estimation of coating properties from slow-strain rate tensile testing curves.

The considered case of computational analysis of PEO-coated magnesium damage is an example of the industrial relevant problem which extremely needs the support of modelling to accelerate the development process and manufacturing integration. From the other hand, it is well known that materials modelling is considered as a European Science Technology strength but needs far more implementation and use in industry to reap its full economic impact. To force the benefits of the modelling to industrial use, integration of industrial case into modelling solution is provided by specialists called Translators. Some aspects of Translation implementation and correlation with innovation case using in the frame of Open Translation Environment will be discussed in this presentation.

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