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ACCEPTED MANUSCRIPT

Critical assessment of the determination of residual stress profiles in thin films by means of the ion beam layer removal method

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Abstract:
Residual stresses and their distribution within individual layers are a general concern in thin film technology. Here we use a recently developed ion beam layer removal method to determine the stress profile in a thin film system. The system consists of a thin tungsten and titanium nitride film deposited on a silicon substrate. The stresses are calculated from the deflection of a focused ion beam machined cantilever by means of Euler-Bernoulli beam theory and Finite Element simulations coupled with an optimizing algorithms, and the results of the two methods are critically compared. Case studies taking into account manufacturing related variations in the cantilever geometry, different boundary conditions and relaxation during cantilever fabrication are performed. We find that the stress distribution in the thin film system is strongly influenced by the boundary conditions and the cantilever fabrication, while manufacturing related variations in the cantilever geometry only slightly influence the stress distribution.

Keywords: ILR method, residual stress profile, W and TiN thin films, FE modelling, optimization

1. Introduction

The investigation of local residual stresses is important since they can affect the functionality and lifetime of many components. Residual stresses may occur due to plastic deformation, phase transformation, coating deposition or other inelastic processes. They can be found in

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