Simple method for the determination of the Young's modulus of PVD coatings
Tran, M.D.; Poublan, J.

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Introduction

The residual stresses in thin PVD hard coating can be determined by measuring the curvature change of a thin metal strip coated on one side. If the same strip is being heated, this will result in a curvature change due to the thermal properties mismatch (E, α) between the coating and the substrate. Establishing the relation 1/R=f(ΔT) allows one to evaluate the Young’s modulus of the coating.

Theory

Outline of the method

Calculation

Experiment

Fig.3 Experimental setup

The proposed method will be used to measure the in-plane Young’s modulus of different TiN coating. Through variation of the nitrogen flow (I/Io) during the coating process, TiN of different composition i.e. Young’s modulus can be produced.

Results

Fig.5 1/R=f(T) for different TiN coatings

Fig.6 Young’s modulus as a function of the I/Io ratio

Conclusions

A new method for the determination of the Young’s modulus of thin hard coatings is introduced. The Young’s modulus of TiN coating varied from 300 GPa to 600 GPa depending on the I/Io settings. Since stochiometric TiN has the highest modulus, the optimal I/Io settings can be found at 50%. Above this, the Young’s modulus of the TiN coating approaches the Young’s modulus of pure Ti.

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