

PREDICTION OF RESIDUAL STRESS DISTRIBUTION IN PLASMA NITRIDED TOOL STEEL

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Abstract

Residual stresses may be present in engineering components as an unintended consequence of manufacturing processes, but they may also be introduced deliberately during surface engineering procedures. Plasma nitriding and nitrocarburizing are such processes of particular importance for tool steel components used in tool, die and machine applications. These processes afford significant advantages, such as greatly improved wear and corrosion resistance, as well as fatigue strength resulting from the generation of near-surface compressive residual stresses.

A precise knowledge of the level and distribution of residual stress that exist in such engineering components is necessary for product development and quality control purposes, as well as for the accurate prediction of a component's fatigue resistance. If located at the same depth as the Hertzian stress concentrations, compressive residual stress can greatly improve the fatigue properties of loaded surfaces. Therefore, reliable methods for residual stress determination are required, with residual stress measurement techniques having their limitations.

The aim of this investigation is to correlate the residual stress distribution in plasma nitrided and nitrocarburized tool steel with the microhardness depth profile, in order to determine whether a relatively simple microhardness-related parameter could be used to predict the depth of the maximum compressive residual stress, and to thereby enable optimization of the nitriding parameters for specific contact conditions.

Keywords: Plasma nitriding, Nitrocarburizing, Residual stress, Microhardness, Modelling