

## Thermomechanical surface treatment of metallic materials

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It is established that the fatigue lifetimes of metallic materials can be enhanced using mechanical surface treatments, such as shot peening or deep rolling processes. A crack initiation, as well as propagation, can be retarded by generated compressive residual stresses at the surface and in near-surface regions. However, compressive residual stresses can be relaxed as well as decreased during cyclic loading. Dislocation movements, rearrangements or annihilation are the cause of residual stress relaxation. Thus, a stability of compressive residual stresses is crucial for superior fatigue lifetimes as well as performances of mechanically surface treated components. Thermomechanical surface treatments (warm shot peening or high temperature deep rolling) was developed from conventional mechanical surface treatments to stabilize the compressive residual stresses using the dynamic strain ageing concept. Accordingly, dislocations are pinned by solute atoms as well as very fine carbides during the thermomechanical surface treatments. In this presentation, concept, processing and effects of the mechanical and thermomechanical surface treatments will

be addressed. The method to optimize the temperature of the thermomechanical surface treatments will be introduced. Afterwards, some examples of the fatigue performances of various metallic materials, e.g., austenitic stainless steel AISI 304, plain carbon steel AISI 1045, non-precipitation-hardenable aluminium alloy AA5083 and precipitation-hardenable aluminium alloy AA6110 after high-temperature deep-rolling at elevated temperatures will be presented and compared with the conventional deep rolled condition (deep rolling at room temperature). It can be concluded that the thermomechanical surface treatment effectively enhances the fatigue performance of metallic materials having interstitial solute atoms, such as steels. However, for aluminium alloys, the beneficial effects of high-temperature deep rolling are not pronounced due to the different strengthening mechanisms in aluminium alloys having major substitutional solute atoms or precipitates, which need more time to develop.

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