Influence of Microstructure and Process Conditions on Simultaneous Low-Temperature Surface Hardening and Bulk Precipitation Hardening of Nanoflex®

Precipitation hardening martensitic stainless steel Nanoflex was low-temperature nitrided or nitrocarburized. In these treatments, simultaneous hardening of the bulk, by precipitation hardening, and the surface by dissolving nitrogen/carbon can be obtained because the treatment temperatures and times for these essentially different hardening mechanisms are compatible. The effect of the processing history of the steel on the nitrided/nitrocarburized case was investigated by varying the amounts of austenite and martensite through variation of the degree of plastic deformation by tensile strain, deep cooling, and deliberate manipulation of the austenite stability. The nitrided/nitrocarburized case was investigated with reflected light microscopy, hardness-depth profiling, X-ray diffraction analysis, and glow discharge optical emission spectroscopy. The results demonstrate that a microstructure consisting of martensite results in the deepest nitrided case, while a shallow case develops on a microstructure consisting of austenite. For an initial microstructure consisting of both martensite and austenite a non-uniform case depth is achieved. Simultaneous bulk and surface hardening is only possible for martensite because the precipitation hardening does not occur in an austenite matrix.