Title: Martensitic Transformation induced by single shot peening in a metastable austenitic stainless steel 301LN: Experiments and numerical simulation

Authors: Romain Guiheux, Sophie Berveiller, Régis Kubler, Denis Bouscaud, Etienne Patoor, Quentin Puydt

PII: S0924-0136(17)30243-1
DOI: http://dx.doi.org/doi:10.1016/j.jmatprotec.2017.06.015
Reference: PROTEC 15268

To appear in: *Journal of Materials Processing Technology*

Received date: 1-12-2016
Revised date: 31-5-2017
Accepted date: 10-6-2017

Please cite this article as: Guiheux, Romain, Berveiller, Sophie, Kubler, Régis, Bouscaud, Denis, Patoor, Etienne, Puydt, Quentin, Martensitic Transformation induced by single shot peening in a metastable austenitic stainless steel 301LN: Experiments and numerical simulation.Journal of Materials Processing Technology http://dx.doi.org/10.1016/j.jmatprotec.2017.06.015

Martensitic Transformation induced by single shot peening in a metastable austenitic stainless steel 301LN: Experiments and numerical simulation

Romain Guiheux[a], Sophie Berveiller[a, *], Régis Kubler[b], Denis Bouscaud[a], Etienne Patoor[a,1], Quentin Puydt[c]

a : Arts et Métiers ParisTech, LEM3, 4, rue Fresnel, 57070 Metz, France
b : Arts et Métiers ParisTech, MSMP, 2 cours des Arts et Métiers, 13617 Aix-en-Provence, France
c : IRT M2P, 4, rue Fresnel, 57070 Metz, France
* Corresponding author : sophie.berveiller@ensam.eu

Abstract: During conventional shot peening on metastable austenitic steels, martensitic transformation occurs in addition to plastic straining. In this work, the impact of a single spherical steel shot on a AISI 301LN steel was studied. The volume fraction of martensite, residual stresses in both phases were determined in the vicinity of the dent as a function of the shot velocity and diameter. An elasto-plastic two phase model that includes martensitic phase transformation was adapted to model mechanical and microstructural fields and implemented in Abaqus Explicit for the 2D simulation of a single shot impact. It was found, for instance, that the martensitic transformation takes place only under the dent and that martensite is in tension at the surface while austenite is in compression. Simulation results of stress levels showed a good agreement with experimental stresses determined by X-ray diffraction.

Keywords: shot peening, austenitic steel, martensitic transformation, residual stresses, finite element modeling

1. Introduction

Metastable austenitic stainless steels combine very good mechanical properties and high formability. They are good candidates for lightweight materials in automotive and other industrial sectors like energy and aviation. This remarkable combination of properties results from transformation induced plasticity. Formation of strain-induced martensite during the deformation process increases the strength level of the material. Mechanical and structural components must exhibit high mechanical resistance and high formability, but also high fatigue resistance. Shot peening surface treatment is commonly used in mechanical industry to increase fatigue resistance from the introduction of high compressive residual stresses that delays fatigue failure of component (Lillamand et al. 2001). Evaluation of these stresses is of first importance to optimize component design and process parameters. The numerical simulation of the influence of shot-peening process on the internal stress field distribution on the near surface is a useful but

[1] Present address: UMI GTL, 2 rue Marconi, 57070 Metz, France