

## Accepted Manuscript

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Ankur Kumar Agrawal, Aparna Singh, Anupam Vivek, Steve Hansen, Glenn Daehn

PII: S0167-577X(18)30638-4  
DOI: <https://doi.org/10.1016/j.matlet.2018.04.044>  
Reference: MLBLUE 24211

To appear in: *Materials Letters*

Received Date: 10 February 2018  
Accepted Date: 10 April 2018

Please cite this article as: A.K. Agrawal, A. Singh, A. Vivek, S. Hansen, G. Daehn, Extreme Twinning and Hardening of 316L from a Scalable Impact Process, *Materials Letters* (2018), doi: <https://doi.org/10.1016/j.matlet.2018.04.044>

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**Extreme Twinning and Hardening of 316L from a Scalable Impact Process**Ankur Kumar Agrawal<sup>1</sup>, Aparna Singh<sup>1\*</sup>, Anupam Vivek<sup>2</sup>, Steve Hansen<sup>2</sup>, Glenn Daehn<sup>2</sup><sup>1</sup>Department of Metallurgical Engineering and Materials Science, Indian Institute of

Technology Bombay, Mumbai 400076, India

<sup>2</sup>Department of Materials Science and Engineering, The Ohio State University, 2041 College

Road, Columbus, OH 43210, USA

**Abstract:** A strain of 10% is applied to 316L stainless steel specimens at strain rates of  $7.7 \times 10^4 \text{ s}^{-1}$ ,  $200 \text{ s}^{-1}$  and  $50 \text{ s}^{-1}$  using vaporizing foil actuator (VFA) technique for the highest strain rate and dynamic plastic deformation (DPD) for the lower strain rates. There is a dramatic increase in hardness with increasing strain rate, rising to over 2.2 GPa at the highest strain rate. While the average twin thickness remained similar across different strain rate regimes, a dense criss cross pattern of twins is formed at the highest strain rate from activation of deformation twinning in non-parallel planes. This shows promise for VFA driven flyers process as a method for surface modification and hardening.

**Keywords:** Nanotwins; Austenitic Stainless Steel; VFA; Impulse Processing; Nanocrystalline materials; Indentation and hardness

**1. Introduction**

Twinning mode of plastic deformation leaves behind twinned regions and interfaces that act as obstacles to further deformation by twinning or dislocation motion. High strength, ductility, wear resistance, thermal stability, improved fracture toughness and enhanced sub-critical fatigue crack growth life have been observed in metals with twin thickness in the nanometer regime [1–5]. A material with low stacking fault energy (SFE) deformed at low

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