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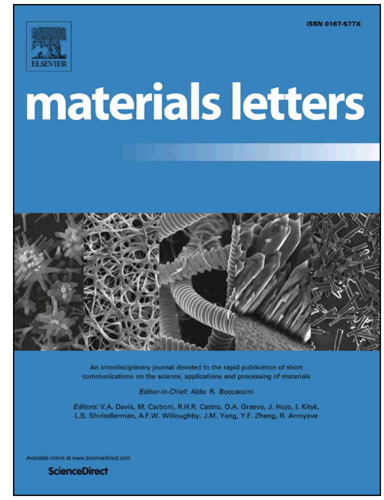

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Extreme Twinning and Hardening of 316L from a Scalable Impact Process

Ankur Kumar Agrawal[1], Aparna Singh[1*], Anupam Vivek[2], Steve Hansen[2], Glenn Daehn[2]

[1]Department of Metallurgical Engineering and Materials Science, Indian Institute of Technology Bombay, Mumbai 400076, India

[2]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 7.7×10^4 s^{-1}, 200 s^{-1} and 50 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