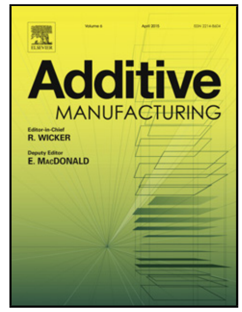
Accepted Manuscript



Title: Understanding deposition mechanism in cold sprayed ultra high molecular weight polyethylene coatings on metals by isolated particle<!–<query id="Q1">Please check whether the designated corresponding author is correct, and amend if necessary. </query>–> deposition method

Authors: Kesavan Ravi, Tiana Deplancke, Kazuhiro Ogawa, Jean-Yves Cavaillé, Olivier Lame

PII: S2214-8604(17)30137-9
DOI: https://doi.org/10.1016/j.addma.2018.02.022
Reference: ADDMA 296

To appear in:

Received date: 24-3-2017
Revised date: 26-9-2017
Accepted date: 27-2-2018

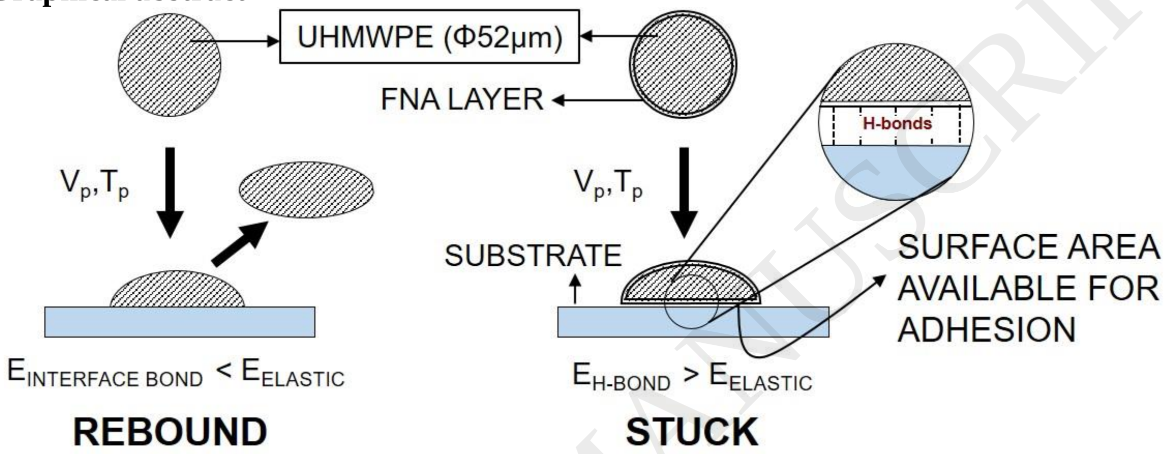
Please cite this article as: { https://doi.org/

UNDERSTANDING DEPOSITION MECHANISM IN COLD SPRAYED ULTRA HIGH MOLECULAR WEIGHT POLYETHYLENE COATINGS ON METALS BY ISOLATED PARTICLE DEPOSITION METHOD

Kesavan Ravi [1,2,3], Tiana Deplancke[2], Kazuhiro Ogawa [1,3], Jean-Yves Cavaillé [3], Olivier Lame[2]

1) Fracture and Reliability Research Institute, Tohoku University.
2) Material Engineering and Science lab, MATEIS, INSA Lyon – CNRS.
3) ELyTMaX, UMI 3757, CNRS, Tohoku University and Université de Lyon, International Joint Unit, Tohoku University.

Graphical abstract



Abstract

The cold spray has been shown to be one of the promising additive manufacturing technologies to process Ultra High Molecular Weight Polyethylene (UHMWPE)-metal integrated systems by successfully being able to coat UHMWPE on metals using fumed nano-alumina (FNA) as UHMWPE particle surface modifiers. However, the exact mechanism of UHMWPE deposition and role of FNA was widely unknown. This study aims at identifying the fundamental parameters involved in high strain-rate UHMWPE deposition and their role in successful adhesion. A technique called Isolated Particle Deposition (IPD) is developed to achieve the same. Major parameters that influenced the UHMWPE deposition efficiency significantly were the particle temperature and velocity and net surface activity of FNA. The stored elastic energy of UHMWPE decreases with increase in temperature, and the deposition criterion for a successful UHMWPE deposition is not to have net stored elastic energy/rebound energy after impact. Effect of FNA was seen in generating H-bonds that helped to establish bridge bond at UHMWPE-substrate interface.
Keywords: cold spray; polymer; UHMWPE; deposition mechanism; nanoceramics;

Nomenclature

A_e, A_t	Area of nozzle exit and throat (m^2)	$c_{p,g}$, $c_{p,p}$	Specific heat of gas and UHMWPE particle (J/^oC)	**Pr**	Prandtl Number
T$_{total}$	Total temperature of gas (^oC)	T_i	Initial Temperature of particle (^oC)	**Nu**	Nusselt Number
V_{gas},	Velocity of gas and	k_g	Thermal conductivity of	h	Heat transfer