Polymer Additive Manufacturing:

Fact or Friction?

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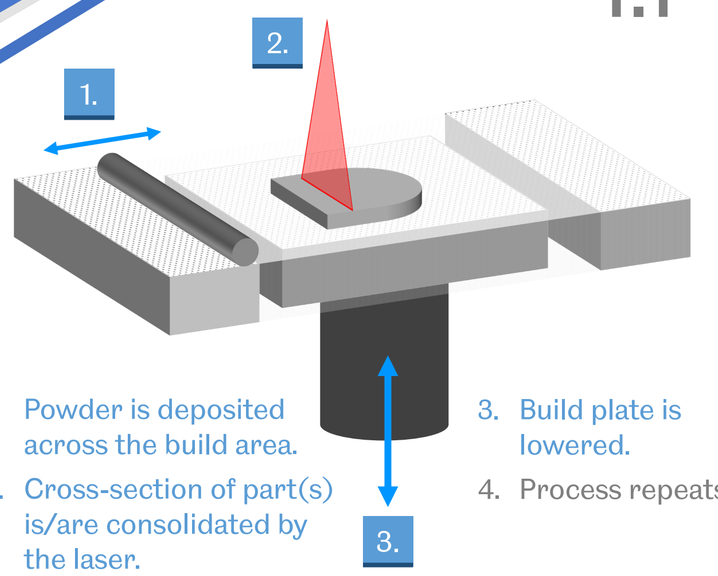
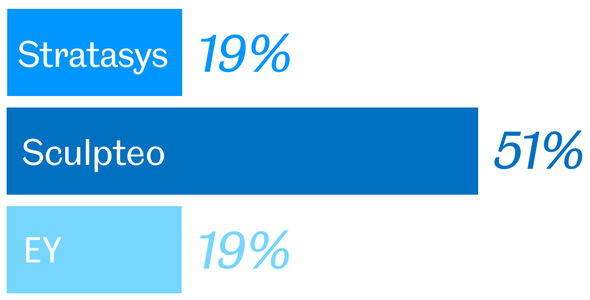
Polymer Laser Sintering (LS) 1.1



1. Powder is deposited across the build area.
2. Cross-section of part(s) is/are consolidated by the laser.
3. Build plate is lowered.
4. Process repeats.

Why isn't polymer AM more popular in industry? 1.2

Part quality is a major challenge companies face using polymer AM
% in agreement as reported by:



Introducing … Tribology

*Tribology is the science and technology of interacting **surfaces** in a state of relative motion, and covers **friction**, lubrication and **wear** in all mechanical contact situations.*

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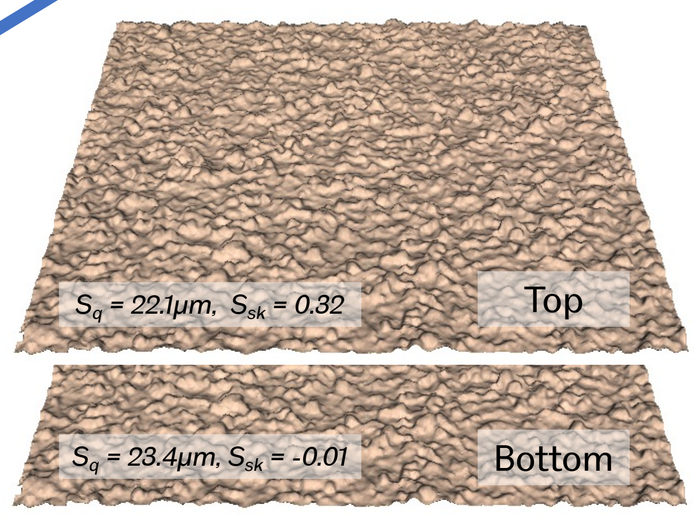
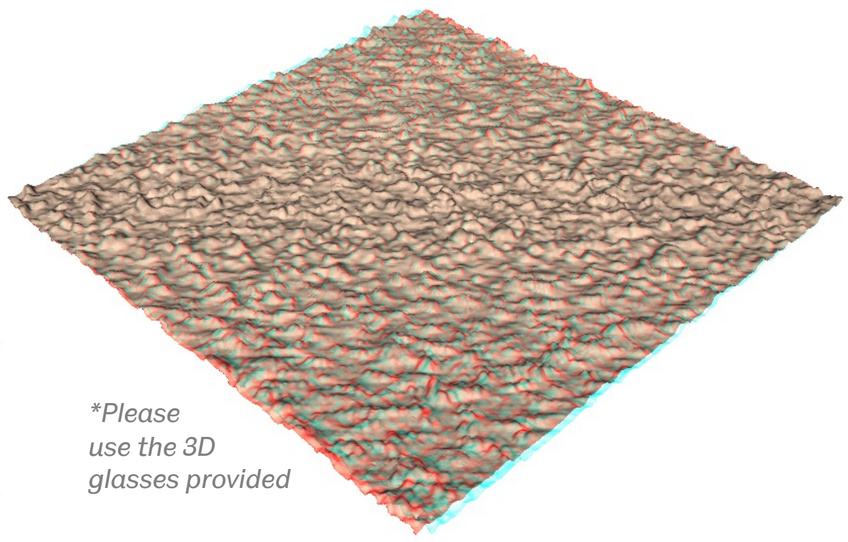
LS Nylon-12 surfaces … in 3D



Focus Variation Microscopy

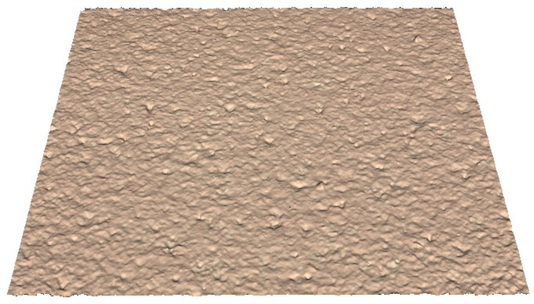


**Please use the 3D glasses provided*

Process modified LS top surfaces 2.1

Building with alternative end of build actions results in a significant change in top surface topography:

- **68% reduction in S_q**
- A transformation to a **pore dominated** surface symmetry.



**Please see illustrative parts*

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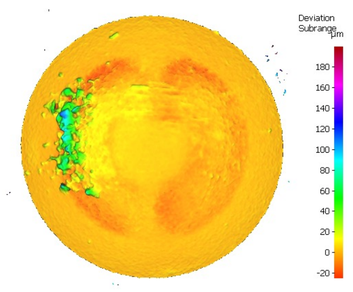
Friction and wear testing

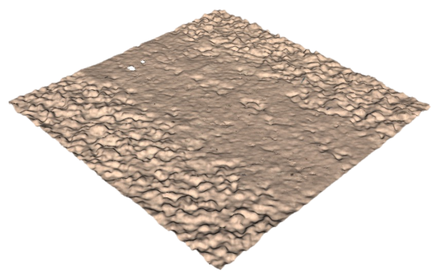
Ball-on-flat, pin-on-disk wear tests

Universal Mechanical Tester (UMT)

Transient regime wear behaviour

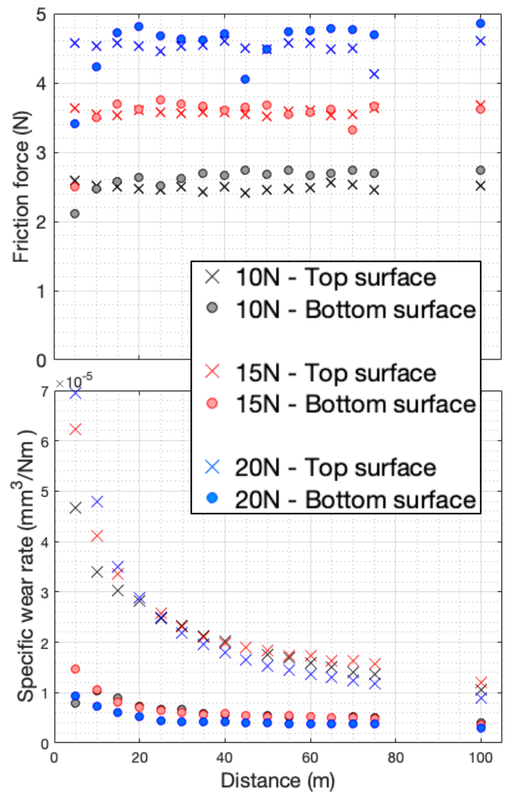


Steel pin



Polymer counterface

- Abrasive wear mechanism dominates.
- Asperity dominated top surfaces generate significantly greater amounts of wear debris – due to fracturing of peaks.
- Despite the above, little difference in frictional response was observed.
- Transfer film formation within the contact area was not observed.



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Future research plans

1) Continue investigating transient regime wear behaviour

2) Measure frictional heating effects.

3) Analyse adhesive contact chemistry by FT-IR spectroscopy.

4) Characterise steady state wear behaviour - *Understand which wear mechanisms are active, dominate and affected by varying operating conditions.*

The University Of Sheffield.

MAPP
Manufacture using Advanced Powder Processes
EPSRC Future Manufacturing Hub

The Leonardo Tribology Centre

Bibliography, publications and more available here:

Poster Presentation

Bibliography

In order of appearance:

[1] Stratasys, Looking Forward : Additive Manufacturing in 2020. A report from 3D printing users, 2020.

[2] Sculpteo, The state of 3D printing 2020, 2020.

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[4] Tribology - IMechE, (n.d.). https://www.imeche.org/industry-sectors/tribology/ (accessed March 27, 2022).