

Replication and Tribological Engineering of Physical Surfaces Using Two-Photon Lithography

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Conventional Materials & Processes

Nanoscience & Engineering

Background

- Replication techniques are difficult to apply to many biosurfaces, and large amounts of data are difficult to process for fabrication
- Nearly 10% of all automotive energy waste comes from the interface between the piston compression ring and the cylinder liner
- There is a need to reduce this friction using surface texturing

Innovation

- A digitization and tiling process is applied to scanned height data to reduce processing need and expand replication capability
- Hierarchical textures can be combined with biomimetic designs
- Inspiration from nature can be used to improve friction

Approach

Learning from nature

- What biostructures do natural surfaces use to reduce friction?
- The designs are created with 3D modeling software

Two-photon lithography to create physical structures

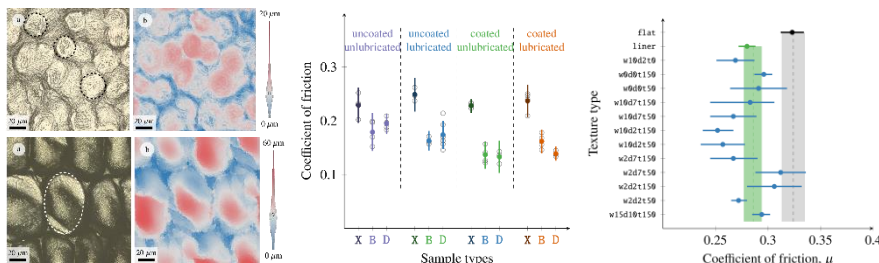
- Printing process allows quick turnaround of testing and development cycle
- Truly 3D surfaces can be created – not just extruded shapes

Digitization and replication by tiling

- Digitization of surfaces allows non-contact replication of topographies
- Other fields using tiling processes to generate large outputs from small inputs

Key Results

- Results show significant friction reduction due to special combination of surface features, published in *Journal of Tribology*
- Paper published in *Journal of Manufacturing Processes* on surface replication of biological surfaces, and in *Biointerphases* on friction reduction from those surface topographies



Potential Applications

- Quick testing cycle of parameter-modified surfaces before robust, complex fabrication
- Reduction of friction in lubricated interfaces



Future/Ongoing Work

- Many bioinspired designs can be studied nondestructively
- Impact of textures in industrial materials



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