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Integrated Laser-Processing Cell

This advanced laser manufacturing process simultaneously constructs precise material properties and dimensions during substrate generation, enabling the creation of complex freeform parts with varying compositions and internal geometries.

A common manufacturing difficulty is the lack of exact knowledge of specific material properties at all dimensions. The process builds on assumed properties and laboratory characterizations via samplings when the end product, such as advanced/high technology or future products undefined as of yet, require knowing exact properties at all dimensions. There currently exists no product or service on the market where the properties at all dimensions are provided.

Researchers at Purdue University have developed an advanced laser manufacturing solution with primary applications on flat surfaces and secondarily on round surfaces. The process allows for the simultaneous construction of explicit material properties and dimensions as the substrate is being generated. Furthermore, the process can provide specific properties in different sections of the material. The primary application for this system is material deposition. In this application, a similar or dissimilar metal or ceramic can be added to the work piece in variable layer thickness and sequences, with the option to machine as needed (micro/nano-channels, micro/nano-holes, etc). This allows the construction of freeform structures and parts with varying composition, layer by layer. This solution can utilize laser heat to assist material removal from a work piece as necessary. The system can also be used to harden or anneal the substrate material. With laser hardening, a work piece can be heated to a precise temperature for a duration of time to change the physical properties of a substrate at specific places to obtain the desired crystalline structure.

Advantages:

-Enables creation of parts with complex internal geometries

-Enables construction of solid parts with varying compositions

TRL: 8

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Materials Science & Nanotechnology/Advanced Functional Materials
Materials Science & Nanotechnology/Composites & Hybrid Materials
Chemicals & Advanced Materials/Materials Processing & Manufacturing Technologies

Authors
Yung C Shin

Further information
Aaron Taggart
adtaggart@prf.org

View online

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