用於增材製造金屬物件的嶄新激光拋光技術

Novel Laser Polishing Technology for Additive Manufactured Metal Objects

有效控制工業及醫療應用中3D打印金屬部件的表面特性

For better control of the surface characteristics of 3D printed metal components in industrial and medical applications

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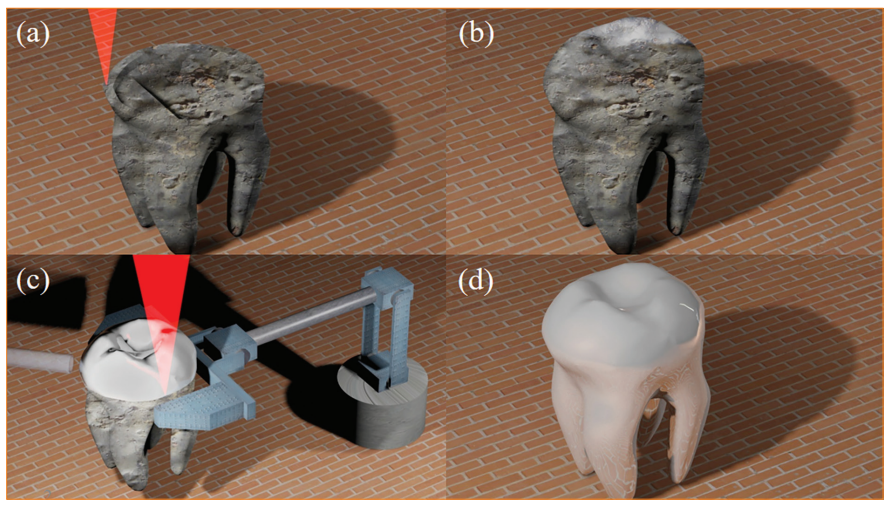
以3D打印（又稱「增材製造」）出來的金屬物件通常有欠細緻，表面粗糙不平，必須經過打磨加工，才能使用。為了有效地控制3D列印金屬部件的表面特徵，團隊研發出一項創新的拋光技術，採用激光輻射重新熔解物體表面的薄層，達到拋光的效果。這項基於重熔原理的拋光技術有別於傳統的磨蝕和磨削加工工序，加上隊團已掌握了 3D 打印金屬物件表面形態與激光參數之間的優化處理相互作用，所以能夠大大提高物件表面的光潔度。此項解決方案既先進，又實用，而且靈活度高，能夠達到傳統金屬拋光技術無法媲美的效果。

特色與優點

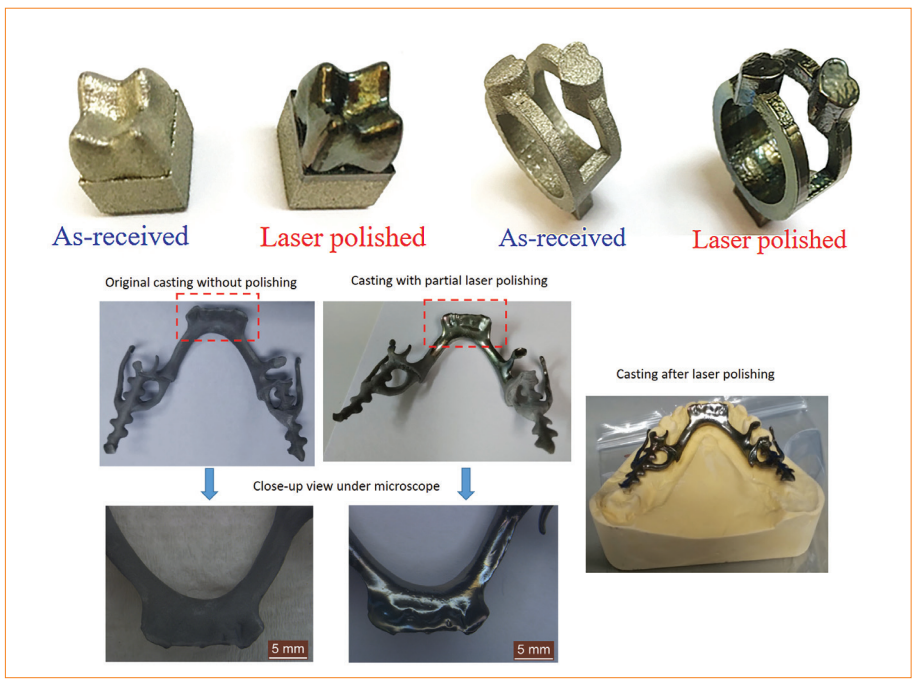
- 利用簡單的激光方法進行拋光
- 可改善 3D 打印金屬物件的表面特性，並可調節氧化程度、電阻和水接觸角度（潤濕性）
- 可即時、直接應用在物件上，無需進行額外的加工工序

應　用

- 家用電器，例如LED燈泡外殼
- 醫療器材，例如膝關節和牙科植入物
- 機械工程，例如螺釘
- 消費電子產品，例如手機外殼



新型激光製造技術示意圖
(a) 以SLS 3D 打印方法製造牙科金屬工件
(b) 製成的牙科金屬工件表面粗糙不平
(c) 在惰性氣體通量環境下，牙科工件由機械臂夾住並接受激光拋光
(d) 完成激光拋光後的牙冠呈現出光滑的表面
Illustration of the new laser polishing technology
(a) A 3D printed dental metal workpiece is being fabricated by SLS
(b) The as-fabricated dental metal workpiece has a rough surface
(c) The dental workpiece is being held by a robotic arm and laser polished under an inert gas flux environment
(d) The finished dental crown shows remarkable surface smoothness after laser polishing



金屬樣品激光拋光前後的照片
(a) CoCr (鈷鉻合金)齒
(b) CoCr 心環
(c) CoCr 活動假牙框架

Photos of metal samples before and after laser polishing
(a) CoCr (Cobalt Chromium) tooth
(b) CoCr heart ring
(c) CoCr partial removable denture

Metal objects created by 3D printing (or additive manufacturing) are often rough in their surfaces and require polishing before they are suitable for use. To effectively control the surface characteristics of 3D printed metal objects, the team developed a novel technology to achieve polishing by remelting a thin surface layer of the objects through laser radiation. Based on the remelting principle, this technology is different from conventional abrasion and grinding processes. What's more, the team has identified an optimal processing interaction between the surface morphology of 3D printed metal objects and laser parameters, and can thus create a superior surface finish. Highly practical and flexible, this advanced laser polishing solution produces results that are unmatched by conventional metal polishing technologies.

Patent No. and Country: 2017111134696 (China)

Special Features and Advantages

- Uses a simple laser method to perform surface polishing
- Improves the surface characteristics of 3D printed metal objects with adjustable oxidation extent, electrical resistance and water contact angle (wettability)
- Can be immediately and directly applied on the objects without secondary processing

Applications

- Household appliances, e.g. LED light bulb casings
- Medical devices, e.g. knee joints and dental implants
- Mechanical engineering, e.g. screws
- Consumer electronics, e.g. cell phone casings

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