附件四、技術說明表

軟體機器人

提案人： 楊燿州 教授
單　位： 國立臺灣大學　機械工程學系/研究所
簡　歷： http://www-mems.me.ntu.edu.tw/

市場及需求:
近年來軟性機器人的發展蓬勃，在工業、醫學、仿生學領域等都有廣泛應用，協助人們完成過去難以達成的任務。為了使爬行機器人穩定向前爬行，往往透過後續加工的方式將不同部件整合，然而此方法會卻會限制軟性機器人微小化的可能性，並提升製作上的困難度。因此，若能夠以一體成型的方式製作爬行機器人，將縮小元件尺寸並於製程控制上將會有很大的益處。此外，具有功能性的爬行機器人是開發的關注項目之一，倘若透過外型設計的方式，設計出具有多功能爬行機器人，將大大提升在複雜環境中應用潛力。

技術摘要(含成果):
開發了一具載物功能之光熱驅動液晶彈性體微型仿生軟性爬行機器人。爬行機器人由兩個小前腿、兩個大後腿和連接腿的凹形載物平台組成。此一體成形的元件透過由微影製程所製作的之模具翻印而成，並採用 LCE 拉伸製程進行形狀記憶特性的編程，並在上方選擇性塗布光熱薄膜以提高近紅外線吸收效率。該元件的運動是透過週期性近紅外線(NIR)照明致動後腿來達到的。當受到近紅外光的照射加熱下，塗布光熱薄膜的區域將會產生宏觀上形變，搭配前後腳尺寸上的差異及前腳的特殊設計，提供元件致動過程中前後不對等的摩擦力，使其往向前爬行，模擬蛇之直線爬行時之鱗片運動。該元件成功利用控制 NIR 照明順序來改變運動方向，也實現了軟性機器人的載物功能。

優勢:
該經過特殊結構設計之元件運動速度超過 2 BL/min，是已發布的基於 LCE 的光驅動爬行機器人中最快的。該設備能夠透過簡單的方式來改變運動方向，也展示了此元件的載物能力，於承載比自身重的負載時仍能以最大速度的一半左右進行移動。此外，此經由微影製程製作之一體成形的軟性微型機器人，無須進行多組件的整合。

競爭產品:
各式微型軟性機器人。

專利現況:
專利申請中

聯絡方式(請不用填):
臺大產學合作總中心
Tel: 02-3366-9945,　E-mail: ordiac@ntu.edu.tw

Soft Robot

PI： Prof. Yao-Joe Yang
Department of Mechanical Engineering, National Taiwan U.

Experience:

Soft robots are capable of complex deformation and versatile locomotion in response to a variety of external stimuli. In contrast to their rigid counterparts, soft robots are generally favored for handling fragile or biological objects and interacting with humans owing to their excellent structural flexibility and unlimited degrees of freedom in deformation.

Market Needs:

Using light stimuli to actuate deformable structures shows promise because it makes possible remote actuation, untethered manipulation, and precise control. In most of the works, the devices that could be easily realized by monolithic fabrication process generally lacked load-carrying capability due to low structural strength. Otherwise, the devices were quite complex due to the need to integrate multiple discrete components. The proposed approach, which combines light-driven actuation and temperature-induced locomotion, potentially broadens the application of soft robots in complex environments.

Our Technology:

This work presents a liquid crystal elastomer (LCE)-based light-driven crawling robot capable of rapid multidirectional locomotion and cargo transport. The proposed LCE device consists of two small front legs, two large rear legs, and a concave cargo platform connecting the legs. It can be fabricated monolithically using a simple soft lithography technique followed by an LCE stretching process for shape programming. The device's locomotion, inspired by the principle of snake-like rectilinear movement, is generated by activating the rear legs with periodic near-infrared (NIR) illumination. The proposed soft crawling robot not only achieves a remarkable speed but also has the ability to change direction and carry loads.

Strength:

The device's speed, which exceeds two body lengths per minute, is among the fastest recorded in published LCE-based, light-driven crawling devices. Furthermore, the device can change the locomotion direction by controlling the actuation sequences of NIR illumination. The device's load-carrying capability is also demonstrated. Additionally, the monolithic process approach eliminates the need to integrate discrete components to generate forces and enable deformation.

Competing Products:

Various miniaturized soft robots

Intellectual Properties: Patent pending

Contact (do not need to fill out):

Center for Industry-Academia Collaboration, NTU
Tel: 02-3366-9945, E-mail: ordiac@ntu.edu.tw