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Non-Confidential Technology Disclosure

Surface Buckling Technique to Fabricate Microlens Arrays Inventor(s): Alfred J. Crosby, Edwin P. Chan

Need for a new technique to manufacture microlens arrays

Microlens arrays (MLAs) are used extensively in telecommunication, sensing, illumination and imaging applications. Conventional microlens fabrication techniques such as surface tension-driven techniques (melt-reflow, ink-jet printing), imprinting methods and lithographic approaches (grey-scale, interference) are either **high-cost** or require **long fabrication times**.

NEW: Surface Buckling Technique for MLA fabrication

This invention presents a new method to fabricate microlens arrays using the concept of **surface buckling** or wrinkling. Spontaneously aligned surface wrinkles are generated via control of local moduli-mismatch through oxidation process and osmotic pressure. The **shape** and **dimensions** of oxidized regions control the local stress state and hence the orient the formation of wrinkles. Microlens patterns can be generated by controlling the extent of lateral confinement of oxidized regions.

Advantages of the Surface Buckling Technique

Low cost and eco-friendly means to generating microlens

The surface buckling technique greatly **simplifies** the fabrication procedure by the elimination of time-consuming and wasteful expensive chemical processes associated with conventional techniques.

Rapid generation of MLAs over macroscopic dimensions

The fabrication technique can be used to pattern larger surfaces than possible economically with conventional techniques.

Relative ease of tuning array dimensions

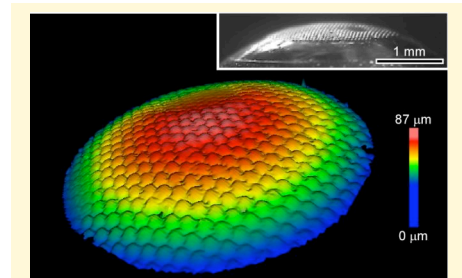
Array dimensions can be easily controlled by changing the extent of oxidation, thereby eliminating the need for multiple molds.

Ability to pattern over non-planar substrates

The surface buckling technique can be used cost-effectively to pattern non-planar surfaces, enabling the production of novel components.

Amenability to a wide variety of materials

This process is amenable to creating relief patterns on a variety of polymer systems to yield a multitude of functional articles.



Optical profile surface of the compound lens fabricated by surface wrinkling. The inset shows the dimensions of the structure.

Some insects have compound eyes consisting of thousands of tiny sensors that detect light and sometimes color. Compound lens arrays produced by the buckling technique may be used in motion detectors, micro-vision systems and communications.

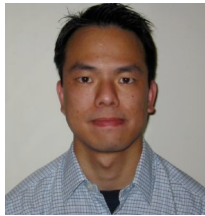
Market Information

Microlens arrays are used extensively for **optical data transmission** in telecommunication applications such as **DWDM, switching, attenuating, fiber collimating** and **coupling**. They are used in **sensing** (Shack-Hartman wavefront sensors), **illumination** (flat panel displays, LCD displays) and **imaging** (CCD image sensors, 3-D photography) applications.

About the Inventors



Alfred Crosby is an assistant professor at the Polymer Science and Engineering (PSE) Department at the University of Massachusetts. Crosby's research interests include surface and interfacial mechanics of polymers, the development and use of elastic instabilities for controlling interfacial properties, mechanical strength in polymer–nanoparticle composites, and the development of mechanical properties in biological sheets and soft materials. As a faculty member at UMass, he has received several awards, including a National Science Foundation CAREER Award and the Army Research Office Young Investigator Award.



Edwin Chan is a PhD student in the Polymer Science and Engineering Department at the University of Massachusetts Amherst under the guidance of Alfred Crosby. His research interests center on bio-inspired design of structured materials for control of polymer adhesion, with special emphasis on the development and use of wrinkling instabilities for microfabrication. Chan received the Alan Gent Distinguished Student Paper Award from the Adhesion Society in 2006.

For more information on related research, visit: <http://www.umass.edu/chm/research/index.html>

BUSINESS OPPORTUNITY: Available for Licensing or Research Collaboration

UMA 07-12: Surface Buckling Technique to Fabricate Microlens Arrays

PATENT STATUS: Patent Process Initiated

The Office of Commercial Ventures and Intellectual Property is responsible for evaluating, protecting and commercializing inventions and discoveries created by researchers at the University of Massachusetts. It strives to create a customer-friendly system that assists faculty, staff and students in securing sponsored research funds and to transform ideas, inventions and creative works into commercially viable products, processes and services that have economic payback to the inventors, the sponsors and the university.

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