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Tunable Optical Gratings Based on Buckled Nano-Scale Thin Films on Transparent Elastomeric Substrates

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Inventors

Hanqing Jiang

Assistant Professor

Department of Mechanical & Aerospace Engineering

Hongbin Yu

Assistant Professor

Department of Electrical Engineering

Cunjiang Yu

Graduate Student

Department of Mechanical & Aerospace Engineering

Kevin O'Brien

Postdoctoral Researcher

Department of Electrical Engineering

Yong-Hang Zhang

Professor

Department of Electrical Engineering

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Patent pending

Contact

Bill Loux

Director of Business Development

Arizona Technology Enterprises, LLC (AzTE)

480.884.1996 main

480.884.1992 desk

Email: bloux@azte.com

Background

Diffraction gratings are an important component in several applications including optical telecommunications and spectroscopy. Their usefulness increases if the gratings are externally tunable. To date, the basis for tunable gratings has been hard materials through multiple steps of micromachining technology. Another effort speaks of using the sinusoidal profile generated from compressing a polymer film grating; however this only accomplished a change in the grating amplitude rather than the period, thereby tuning just the intensity. If a grating allowed in-plane tuning of the wavelength of transmitted light, a host of new applications could be realized.

Invention Description

Researchers at Arizona State University have created a tunable optical grating involving a buckled thin film with periodic sinusoidal patterns on transparent and elastomeric substrates. Submicron size sinusoidal gratings have been constructed with a nanometer-thick stiff film coating on a 30% pre-tensioned elastomeric substrate. As the pre-tension is released, the competition between the layers produces a periodic wavy profile. The resulting profile can be simply tuned by mechanically stretching or compressing the structure. Optical transmittance diffraction testing has revealed 85 nm wavelength shifts of the first order diffraction due to stretching of up to 30% of the original grating length.

Potential Applications

- Strain sensing for structural health monitoring
- Biosensing
- Spectroscopy
- Color filters
- Optical telecommunications

Benefits and Advantages

- Simple, low cost fabrication process
- Large tuning range