Mass production and industrial applications of flexible structural materials

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Structural Colors in Nature

Structural colors in nature originate from light interaction with photonic crystals.
The Science behind Structural Colors

Photonic crystal: periodically structured electromagnetic media with lattice constants comparable to the wavelength of light

Photonic Crystals Applications

Optical communications
- Photonic crystal fibers
- Photodetectors
- Optical switches

Consumer electronics
- Semiconductor lasers
- LCD and LED displays
- LED lighting

General Industrial
- Structural color
- Security materials
- Sensor

Renewable energy
- Solar energy harvesting
- Thin film photovoltaics

Electromagnetic Control is Feasible with Photonic Crystals
From Rigid to Flexible Photonic Crystals

Rigid

Photonic Crystal Fiber

Flexible

Color Sensing

LED with PC Structure

Photonic crystals cause active color change in chameleons

Negative Index Metamaterial
Industrial Scale Manufacturing
Tunable Color Change
Commercialization Case: Color-shifting Gradient Aurora Effect

**Process:**
- Continuous vs. batch

**Performance:**
- Aesthetic diversity

**Cost:**
- low vs high

**Gradient Color across Visible Light Spectrum**
- (roll-to-roll film lamination)

- Glass
- Optical adhesive
- Photonic crystal
- Layer(s)
- Optical adhesive
- Others

**Physical Vapor Deposition (PVD)**
- (current technique for Aurora coating)
Components
High order symmetry (e.g. strawberry)
Asymmetry (e.g. Janus)
Mesoporous

Electromagnetic Control

Microstructure
Photonic crystal
Double gyroid

Chemical
Organic
Semiconductor
Metal
Path for New Material Commercialization

• Understand the value proposition
• Clear picture of the value chain, entry barriers and key influencers
• Commercialization strategy / direction

From proof-of-concept prototype by nanofabrication to industrial production & commercialization
## Acknowledgement

### CAFOE
Chinese Academy of Engineering

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Thank you for your attention!

Science Makes Colorful Life