

以微/奈米週期結構開發節能玻璃

執行單位

清華大學動力機械系

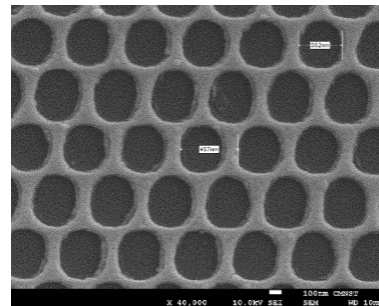
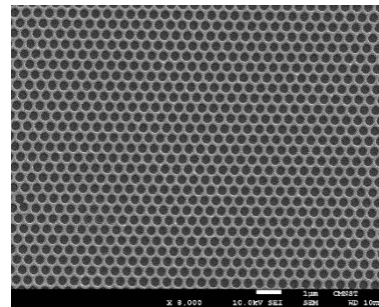
計畫主持人

陳玉彬教授

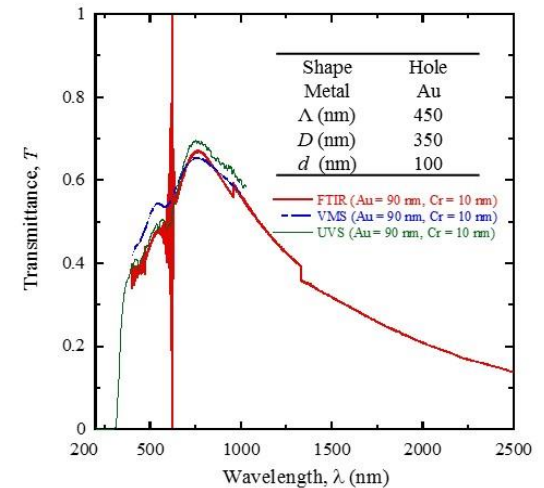
- 本計畫開發壓印及轉印連續製程，可大面積製造具小線寬週期結構之節能玻璃，應用在綠建築、運輸工具及其他亞熱帶與熱帶使用大面積玻璃之場域，同時節省空調及照明用電。

計畫成果衍生專利

- 用於製造導電結構的反應墨水以及方法，中華民國發明，證書號碼 I529223
- 使電致變色裝置著色與去色的方法，中華民國發明，證書號碼 I541580
- 數位式滾筒模仁製造系統，中華民國發明，證書號碼 I545394
- Photomask and method for manufacturing photomask，韓國發明，證書號碼 KR 10 -1655035
- 光罩，中華民國發明，證書號碼 I559074
- 溫感水凝膠組成物及具有該組成物的敷料，中華民國發明，證書號碼 I559941
- 三維光子晶體、其製造方法及其製造設備，中華民國發明，證書號碼 I560138
- 節能玻璃及其製造方法，中華民國發明，申請案號 105116018(發證中)



圖一 節能玻璃4 × 4 cm²樣本SEM圖



圖二 樣本正向穿透率頻譜量測頻譜，結果顯示可見光波段高穿透可節省照明用電，紅外光低穿透可降低空調用電。

- 技術介紹

本計畫利用次波長二維週期結構開發節能玻璃，以較現有多層膜技術更先進方式，利用結構尺寸、排列、與材料多彈性自由度，實現理想之波長選擇光學性質。計畫成果之節能玻璃具體目標：降低紅外線熱輻射進入室內以減少空調用電、阻絕紫外光穿透以避免傷害人體、降低可見光反射以減少對建築物外圍環境之光害、保持可見光穿透以減少室內照明耗能等。

- 核心技術與發展情形

1. 建立數值模型並結合優化理論，高效率模擬輻射性質與優化結構外貌。
2. 開發壓印及轉印連續製程，大面積製造具小線寬週期結構之節能玻璃。
3. 建構對波長及方向皆具有高解析度的寬頻(0.3 μm – 12 μm)半球熱輻射性質量測系統。

- 競賽獲獎

陳玉彬教授及其指導之碩士生施富元、陳彥翔、黃庭軒，三人團隊以「節能金瀨王」榮獲2016全國住商與運輸節能創意實作競賽住商節能組金獎。



Development of energy-saving glass using micro/nano periodic structures

Execution Unit

Department of Power Mechanical Engineering, National Tsing Hua University

Project Director

Dr. Chen, Yu-Bin

- This project successfully a energy-saving glass with wavelength-selective transmittance thanks to tiny periodic structures. High transparency in the visible can save illumination cost, and the opaqueness in the infrared region can reduce air-conditioning expenses. The energy-saving glass is highly attractive to windows of green buildings and transportation vehicles.

Patents

- Reactive Ink for Forming Conductive Structure and Method of Making Conductive Structure, ROC Patent No. I 529223
- Colouring and Bleaching Processes of Electrochromic Device, ROC Patent No. I 541580
- 數位式滾筒模仁製造系統 · ROC Patent No. I 545394
- Photomask and method for manufacturing photomask · KOREA Patent No. KR 10 -1655035
- Photomask, ROC Patent No. I559074
- Thermosensitive Hydrogel Composition and Dressing
- Having the same, ROC Patent No. I 559941
- Three-Dimensional Photonic Crystals Assembly, Method for Manufacturing the Same, and Device for Manufacturing the Same, ROC Patent No. I 560138
- Energy-saving Glass and Method of Manufacturing the Same, Application No. 105116018

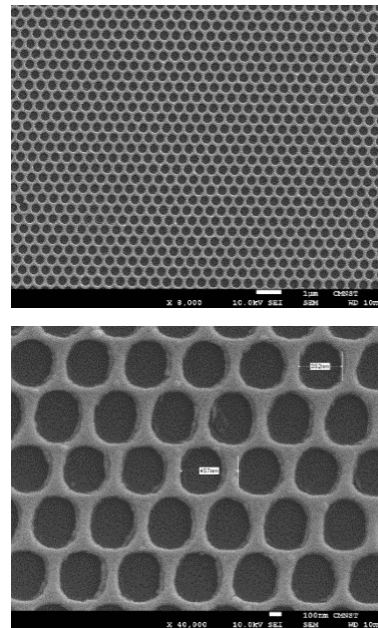


Fig. 1 SEM images of an energy-saving glass sample.

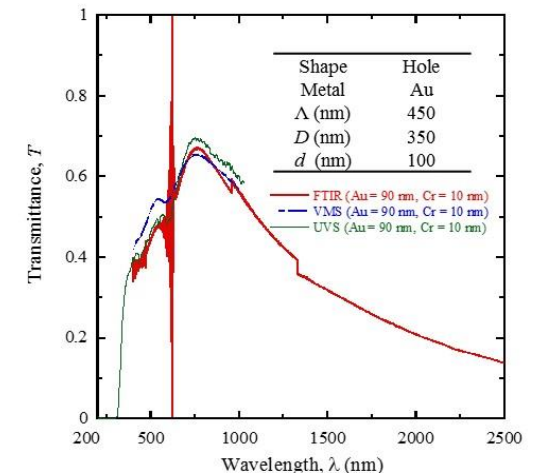


Fig. 2 Normal transmittance spectra of samples.

● Project Highlights

• Technical Brief

This projects developed a energy-saving glass using sub-wavelength periodic structures, outperforming currently commercial ones. The proposed glass takes advantages in structure dimensions and material variety to realize wavelength-selective transmittance. High transmittance in the visible and opaqueness in the infrared regions can save indoor illumination and air-conditioning costs, respectively.

• Major Outcomes

1. A numerical model incorporating optimization algorithms.
2. A cost-effective nano-imprinting process for mass fabricating sub-wavelength structures on a glass substrate.
3. A measurement system for hemispherical radiative properties at wavelengths from 0.3 μm to 12 μm .

• National Award

Dr. Chen and his lab mates received gold medal in the contest, “2016全國住商與運輸節能創意實作競賽.”

