

# 國立屏東教育大學 101 學年度研究所碩士班入學考試

## 科學文獻判讀 試題

(化學生物系碩士班)

※請注意：1.本試題共二頁。

2.答案須寫在答案卷上，否則不予計分。

### 問答題 (共 100 分)

一、

**An ABCG/WBC-type ABC transporter is essential for transport of sporopollenin precursors for exine formation in developing pollen.**

Plant J. 2011, 65:181-93.

The exine of the pollen wall shows an intricate pattern, primarily comprising sporopollenin, a polymer of fatty acids and phenolic compounds. A series of enzymes synthesize sporopollenin precursors in tapetal cells, and the precursors are transported from the tapetum to the pollen surface. However, the mechanisms underlying the transport of sporopollenin precursors remain elusive. Here, we provide evidence that strongly suggests that the Arabidopsis ABC transporter ABCG26/WBC27 is involved in the transport of sporopollenin precursors. Two independent mutations at ABCG26 coding region caused drastic decrease in seed production. This defect was complemented by expression of ABCG26 driven by its native promoter. The severely reduced fertility of the *abcg26* mutants was caused by a failure to produce mature pollen, observed initially as a defect in pollen-wall development. The reticulate pattern of the exine of wild-type microspores was absent in *abcg26* microspores at the vacuolate stage, and the vast majority of the mutant pollen degenerated thereafter. ABCG26 was expressed specifically in tapetal cells at the early vacuolate stage of pollen development. It showed high co-expression with genes encoding enzymes required for sporopollenin precursor synthesis, i.e. CYP704B1, ACOS5, MS2 and CYP703A2. Similar to two other mutants with defects in pollen-wall deposition, *abcg26* tapetal cells accumulated numerous vesicles and granules. Taken together, these results suggest that ABCG26 plays a crucial role in the transfer of sporopollenin lipid precursors from tapetal cells to anther locules, facilitating exine formation on the pollen surface.

- (一) 請問作者依何證據推測ABC transporter跟sporopollenin precursors (孢粉質前驅物)的運輸有關? (25%)
- (二) “This defect was complemented by expression of ABCG26 driven by its native promoter.” 請依本句話試說明作者於本數據的大致實驗設計流程與結果。(25%)

二、

Synthesis of TiO<sub>2</sub> Nanoparticles on Plasma-Treated Carbon Nanotubes  
and Its Application in Photoanodes of Dye-Sensitized Solar Cells

Shouwei Zhang,<sup>†,‡</sup> Haihong Niu,<sup>‡</sup> Yan Lan,<sup>†</sup> Cheng Cheng,<sup>†</sup> Jinzhang Xu,<sup>‡</sup> and  
Xiangke Wang\*,<sup>†</sup>

*J. Phys. Chem. C* **2011**, 115, 22025-22034.

Since Oregan and Gratzel<sup>1</sup> made their breakthrough with a new type of solar cell in 1991, dye-sensitized solar cells (DSSCs) based on TiO<sub>2</sub> nanocrystalline photoanodes have attracted considerable attention owing to their simple process and relatively high energy conversion efficiency. Compared to commercial silicon-based solar cells, DSSCs promise lower fabrication cost and offer higher benefits as compared with amorphous silicon solar cells.<sup>2-5</sup> Despite the fact that power conversion efficiencies of 11% have been attained with DSSCs, further improvements in the performance of these solar cells are still necessary.<sup>6,7</sup> The transport of photoinduced electrons across the TiO<sub>2</sub> nanoparticle network is the major concern to attain high overall light-to-electricity efficiency in the working electrodes. Rapid photoinduced electron transport in a DSSC electrode ensures the efficient collection when it competes with the charge recombination processes.

本段文章是描述染料敏化太陽能電池(DSSCs)特性，試說明文章大意。(25%)

三、

Graphene: Status and Prospects

A. K. Geim

*Science* 2009, 324, 1530-1534

Graphene is a wonder material with many superlatives to its name. It is the thinnest known material in the universe and the strongest ever measured. Its charge carriers exhibit giant intrinsic mobility, have zero effective mass, and can travel for micrometers without scattering at room temperature. Graphene can sustain current densities six orders of magnitude higher than that of copper, shows record thermal conductivity and stiffness, is impermeable to gases, and reconciles such conflicting qualities as brittleness and ductility. Electron transport in graphene is described by a Dirac-like equation, which allows the investigation of relativistic quantum phenomena in a benchtop experiment. This review analyzes recent trends in graphene research and applications, and attempts to identify future directions in which the field is likely to develop.

本段文章是描述石墨烯(graphene)材料的特性，試說明文章大意。(25%)