公司的發展，「研發」為其根、「真實」為其本。

-- 林 江 珍 2019-9-1 --

Why R&D Matters for Taiwan?

(為什麼[研發]對台灣重要?)

-- 從我的36年研發經驗談起 --

(研發是科學求真.產業求發展之根 / 是規劃能力之本)

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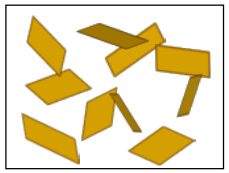
2016-6-17 台大高分子所



National Taiwan University

JJ Lin Polymer Institute

What is Science and Technology ? 科技?

- Science (哲)理

  "searching for the principles of the Nature, and always asking why? "

  "searching for the truth (真) of the things"

  "0 → 1" and problem creating" ==> **Research 研究**

- Technology 工(藝)

  "searching for the benefits (好/善) to the Mankind, and always asking how?"

  "searching for the efficiency of doing things"

  " n → n+1 and problem solving" ==> **Development 開發**

  Science + Technology = SciTech 科技

What is R&D? [研發] ?

(revealing "the same and not the same" 相同或不相同之區別?)

* Academic research (R) vs. Industrial development (D)

"站在巨人的肩膀上" --牛頓-- literature/patent reading and learning …

"撿貝殼的男孩" --牛頓-- curiosity and having funs (求真/好玩/樂趣 之本質)

"我不要做 me too 的研究！"

R or D? R = D?

"配方 formulation" "pilot study and scale-up" "cost-down" … is D but not R !

R is ""Zero to One" 0 → 1 打開運作的祕密" --Peter Thiel--

研發創新(學術與產業)之台灣定位

產業結構發展: R & D & M & M

- research & development → manufacturing (生產) & marketing (市場)
- research (學理探討) vs. technology development (技術應用) → commercialization (商業化)

Historical evolution 歷史演化

Europe/US: R → D → M → M (cycles)

Japan: D → M → M → R (cycles)

Taiwan: starting from Marketing (M) → M → D (d) (停滯於"技轉與代工")

(1990's evolution) e.g., Shell Research Center → Shell Technology Center

e.g., Monsanto, Dow, DuPont, Exxon… merging and evolution to diversifying

(2010's integration) 跨技術 / 領域 / 產業 / 市場…高度整合/競爭)

公司R&D 之多種型態
(and what is yours?)

1. 道聽塗說型
2. PowerPoint型 (managers, CEO and decision makers)
3. 申請政府補助/計畫委託型 (計畫結案乃為最終目標)
4. 專利學習型: 搜索 (surveillance), 可能侵權(infringement), 摸仿可能抄襲/剽竊 (plagiarism)
5. (top-down) 技術移轉/引進型 (知其然不知所以然)
6. (bottom-up) 研發中心: 訓練一群動手做實驗研發人員 ----從淺碟型(學校剛畢業) 乃至 深入探索之能力(in-depth exploratory) (十年磨一劍功力) ; 工程部門: 放大 pilot / demonstration unit ; 商業化:量產/建廠/市場 經驗 ; 以上三部門之整合
7. 未來趨勢: (integration 整合型): 產/官/學/研整合以及shelved technology 再現

Evolution of Chemical Industry Merging into 21st Century
化學產業之世紀變遷

(Consumer Products)

Natural to Synthetic

Fibers (Nylon/PET)

1935~1945

Engineering Plastics

Thermal and mechanical

(PE/PP to PI/PC/PPO…)

1950~1980

Functional Polymers,

Nanocomposites

Bulks,films,fabrics

Bio and Medicals

Acrylates, PU,

Silicon, Polyester, PTFE

Natural Polymers

Photoelectric, solar and ICT

conducting polymers, battery,

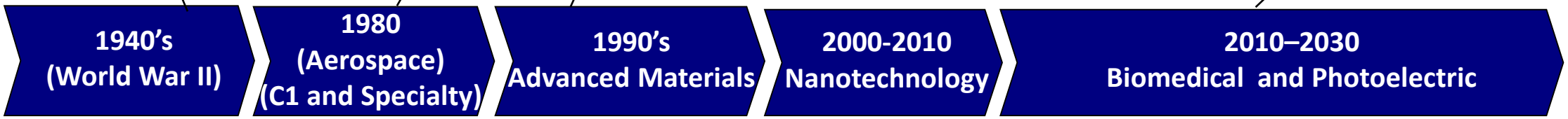
Soft Materials

Bio-related/Renewable

commodity polymers

specialty chemicals to Nanotechnology

(Carbon materials: 1985 C60 ~2004 Graphene ~ 2010)



基本需求大量製造 e.g. PET發明 → 放大/製程 → 應用 (bottles, fabrics and optical films) →→ 未來 (功能性差異化產品)

Future trend/areas:

- **Pharmaceutics and Medical Devices**
- **Energy**
- **Environmental**

Carbon Materials: Chemicals to Plastics (Polymers) to Functional/Hybrids/Soft …

Industry: from Chemicals → Materials → Solar-cell, Bio-medical and ICT

美國歷史重大科技創新: Manhattan Project, 雷達, Project Apollo...

美國關鍵材料之掌握(since 1940)
與知識創新對產業的重要貢獻!

Wallace Carothers
(1896~1937; aged 41; suicide)
Known as the inventor of nylon (DuPont)

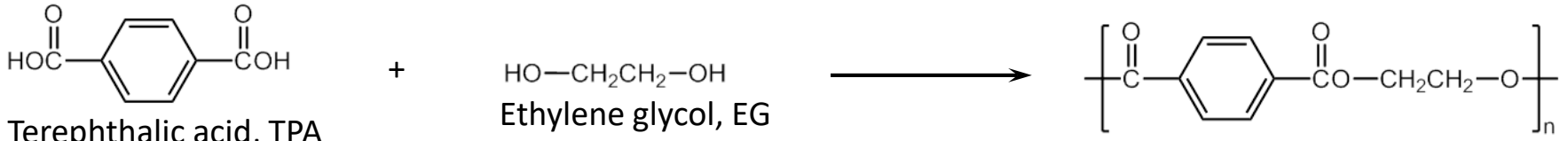
Polyester (PET) and Polyamide (nylon 6,6, a synthetic fiber replacing silk)

Invention: nylon (polyamides) was first made a half-ounce from hexamethylenediamine and adipic acid in 1935

Production: commercialized in 1940 for women's stockings (64 million pairs the first year), 1942 for parachutes...and later for carpeting.

(影響至今且仍震盪不已！)

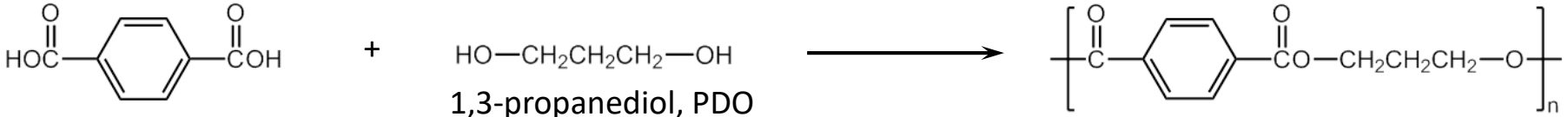
The Example of Commodity Polymers since 1940
大宗聚酯高分子材料之一例 (summarized by JJLin 2016)



Terephthalic acid, TPA

Ethylene glycol, EG

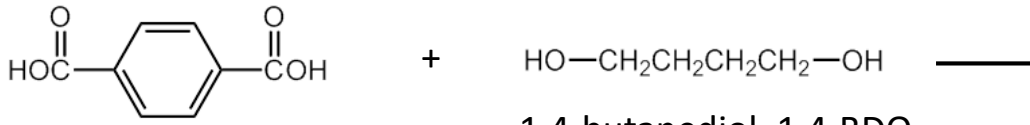
Polyethylene terephthalate (PET)



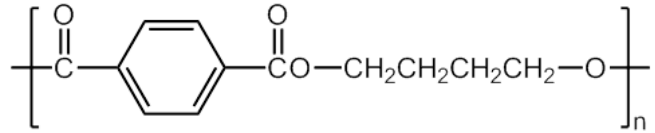
1,3-propanediol, PDO

Polypropylene terephthalate (PPT or PTT)
DuPont (Sorona® fibers), Shell (EO/oxo process)

104. **Jiang-Jen Lin**, J. B. Powell, L. H. Slaugh, T. C. Forschner, T. B. Thomason, P. R. Weider, T. C. Semple, J. P. Arhancet, H. L.-H. Fong, S. B. Mullin, K. D. Allen, D. C. Eubanks and D. W. Johnson, US 5777182 A **(1998)** to Shell Oil Co., **"Cobalt-Catalyzed Process for Preparing 1,3-Propanidiol" from Ethylene Oxide and Oxo Process. (PDO, 7.3萬公噸(1999), PTT Shell's 「CORTERRA」)**



1,4-butanediol, 1,4-BDO
(to PTMEG for PU and polyester TPEE)



Polybutylene terephthalate (PBT)
Engineering plastics

22. **Jiang-Jen Lin** and J. F. Knifton, US 4529808 A **(1985)** to Texaco Inc., **"Bi-Solvent System for the Hydroformylation of Allyl Alcohol Using a Rhodium Catalyst".**
23. **Jiang-Jen Lin** and J. F. Knifton, US 4533742 A (1985) to Texaco Inc., **"Preparation of 2-Hydroxytetrahydrofuran by Hydroformylation of Allyl Alcohol Using Ketone Solvents"**.

1971年 台大化學所 劉盛烈教授 (台灣第一位理學博士) 研究室
慶祝新化合物150種合成成功紀念照 (採自 劉盛烈回憶錄)

左一：黃榮助研究生；左二：陳萬傳助理；左三：李清主助理；左四：吳獻仁研究生；左五：楊美惠副教授；左六：何琴霞副教授；中央：**劉盛烈教授**；右一：江志樞四年級學生；右二：吳文振研究生；右三：沈宗禮研究生；右四：**林江珍**研究生；右五：朱元捷研究生；右六：李國貞研究生

Overview of Advanced Materials and Nanotechnology
(關鍵奈米材料與分散技術--JJ Lin 2001-2015)

技術/材料--點、線、面、體

Conventional Polymers (commodity and specialty)

1. PET (fiber/bottle/film)
2. Polyamides (Nylon 6,6…)
3. Polyolefins (PE, PP, SEBS, EPDM)
4. PMMA and polyacrylates
5. PU
6. PI
7. Epoxy
8. PC … blends/alloys
9. Resins, Films…

Polymeric Dispersants

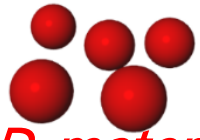
SMA-Jeffamine amines

PTT (branched polyester-polyols)

POEM (POE-imide-amide)

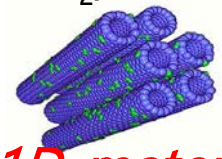
POEU (POE-PU) 核心技術

Dispersion Technology



0D-material

Ag, Pt, TiO_2, ZnO, CuO, SiO_2, RGB…



1D-material

CNT, Ag, SiO_2 wire

2D-material

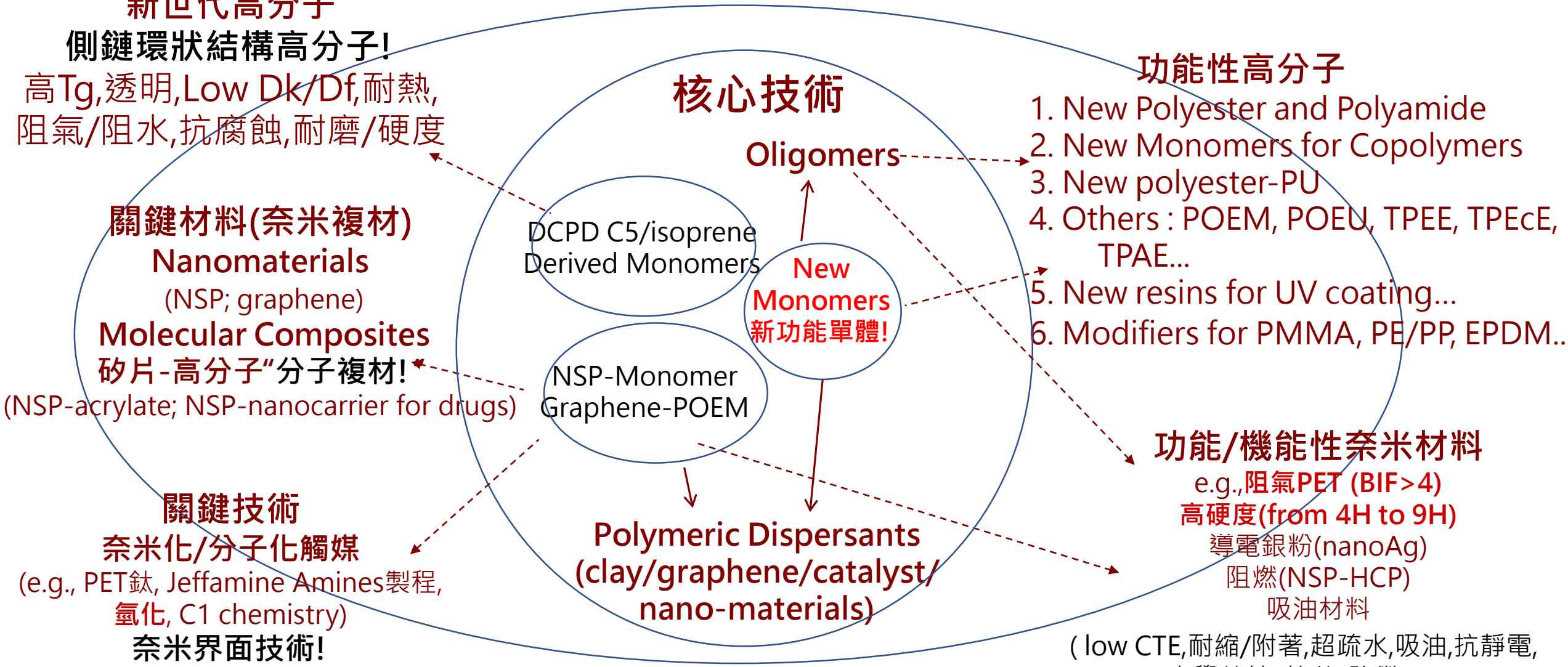
Clay, Graphene

- Hardness and gas/water barrier
- thermal stability
- thermal conductivity
- electric conductivity
- Antimicrobial surface
- anti-flame, fire-retardants, anti-heat
- super-hydrophobic and anti-fouling surface

Electronic and Solar Cells

- Quasi-solid and polymer electrolytes
- DSSC (transparent/flexible/performance)
- New display and flexible/

新高分子材料與奈米功能產品設計方略 (台大)林江珍2015



分子設計(新單体與*免分散*複材)

學術研究與產品開發 (R+D)

可以相輔相成 不會衝突
可以共振以發掘隱藏的秘密與樂趣
也可以解決問題與創造極大的產值！

— 林江珍 2016 —

為什麼[研發創新]重要?

為了人類/環境永續經營; 也為了台灣產業之新世代發展。

如何作好的[研發創新],創造價值?

發掘隱藏的價值! 在意想不到之處發現價值!

研發人要有 從0至1 之創新能力及精神,

不應只**習慣或滿足**於 n to n+1 之小創新。

— 打開世界運作的祕密 — (“Zero to One” by Peter Thiel)

*走人跡稀少的路,看到隱藏的祕密與機會,而且樂意**告訴別人!** **(JJ Lin 2016)**

台灣轉型之缺鏈: 關鍵材料之供應鏈/關鍵技術之深耕與延伸...
(從過去之長處轉型至能參與[未來世界產業體]之關鍵一環)

Mapping 台灣關鍵材料產業

—從奈米材料分散之案例說起—

Mapping Taiwan future key materials' industry

林 江 珍

國立台灣大學　高分子研究所

「近代工程技術討論會」METS
高值石化產業
Nov 11, 2014

National Taiwan University
JJ Lin Labs, Polymer Institute

「Boys, Be Ambitious！」

-- Professor Clark --