



Technology, Economics and Strategy of Recycling Polymeric Materials

Jiang-Jen (JJ) Lin (林江珍)
Emeritus Professor of National Taiwan University
Visiting Professor of National Chung-Hsing University
jiangjenlin@gmail.com

2019

Strategy: Integrating gaseous CO₂ into recycled PET via ethylene-carbonate monomer to make the high-value-added polymers

2018-8-7 Taiwan News 〈時評〉循環經濟 - 小循環vs.大循環以解決海洋塑膠汙染問題: (林江珍、謝國煌 / 台大教授)
塑膠汙染海洋問題需要改變策略，跳脫廢物再生之[小循環經濟]思惟，依循大自然存在化學轉換法之[大循環]，才能根本解決。

- <https://www.taiwannews.com.tw/ch/news/3501261>

Title: Circular Economics: small recycling vs. large recycling for solving the problem of Plastics Waste in Ocean (by Professors JJ Lin and KH Shieh)

Abstract: The seriousness of the plastic waste in ocean will not be solved by the current “small recycling” system. Instead, a new system of “large recycling” based on Polyester chemistry is proposed.

A paradigm change is needed to shift from Polyolefins to Polyesters in a economically feasible manner is urgently needed.

Conclusion: Circular Economics — Recycling Polymeric Materials

Why PET?



(polyester vs. polyolefin)

(hydrolysis and
biodegradability)



Technology

process feasibility
proven and patented

A. Chemical Conversion
(trans-esterification)
to a number of products

B. by EC (carbonate) exchange
reaction to PCPE, TPEcE ...

Economics

(a host of applications)

(1) TPEE elastomers

(2) For PU industry (new polyols)

(3) For Nylon 6T engineering plastics

- ---integrating r-PET chemical recycling and CO₂-derived polymers to solve the world problem: ---

TCCT (Taiwan Carbon-Credit Technology)

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

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

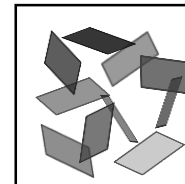
林江珍

([JJ Lin](#))

「近代工程技術討論會」METS

Nov 11, 2014

JJ Lin TAC ITRI 2020



National Taiwan University

JJ Lin Labs, Polymer Institute

Nanotechnology, Dispersants and Applications

(JJ Lin 2001-2019)-- 分散技術為所有奈米材料應用之關鍵--

技術/材料之擴展 --點、線、面、體
傳統至前瞻科技產業之大趨勢

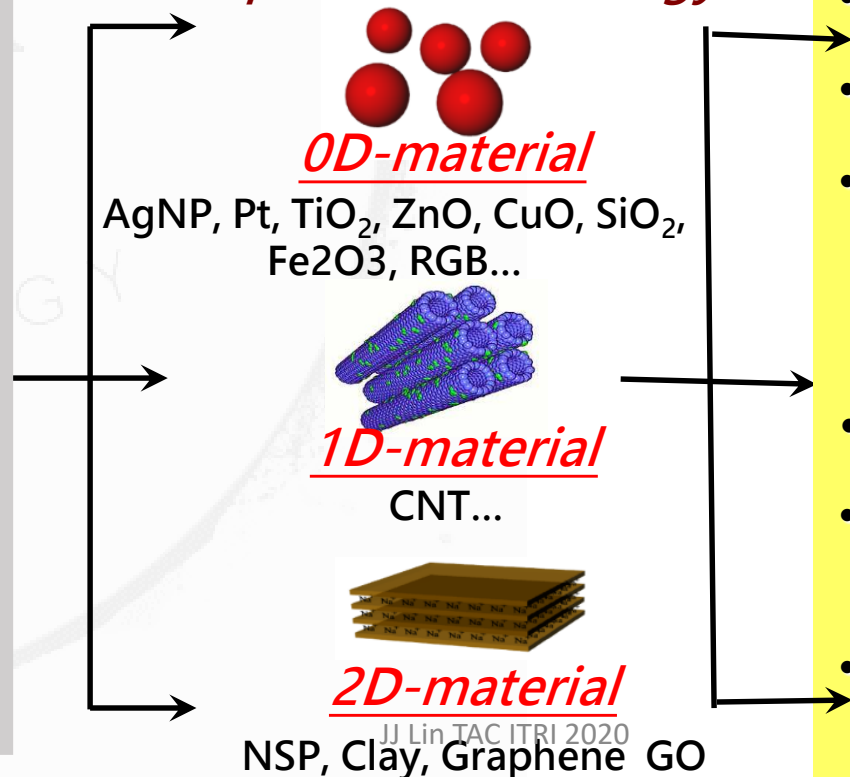
Conventional Polymers (commodity and specialty)

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)

Dispersion Technology



- 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/transparent/ high T_g

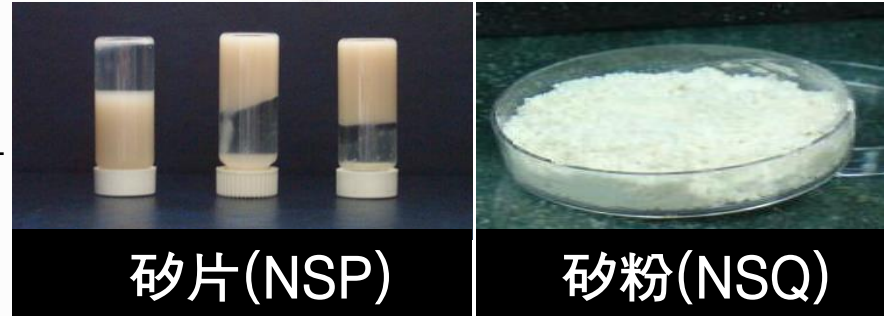
[天然奈米矽片]之發明與其多元應用

Versatile applications of the Natural Nano Silicate Platelets (NSP)

複合材料：阻氣、低熱脹係數、硬度、耐磨、耐燃/耐熱/阻熱、表面抗菌/超疏水、抗靜電、低介電 (Dk/Df)
Nanocomposite/Polymer additives : Gas barrier (PET), CTE, Hard Coating, Anti-abrasive, Fire-retardant/Anti-flame, Anti-statics, Surface anti-microbial/self-cleaning, Low K)

新型分散劑

New dispersants (I/O) for nanoparticles, pigments, 螢光粉, etc.



矽片(NSP)

矽粉(NSQ)

抗火焰膜/塗料/耐燃劑

Inorganic/Organic (I/O) film for anti-flame film/coating, and fire-retardant additives

水處理

(吸附菌/毒素/農藥/重金屬)
Water-Treatment: Absorbents for bacteria, toxins, insecticides, heavy metals, etc.

農業植物/畜牧/漁業

抗菌及防病蟲害
取代農藥/抗生素
Insecticide-free and Antibiotics-free agriculture/livestock/soil: Anti-bacteria, -fungi, -virus for crop/seed/environment

個人衛生/家庭/環境用

清潔劑/防霉/抗蚊蟲/除臭劑
Household & Heavy-duty Detergents; de-odorants, etc.

癌細胞醫療: 藥物標靶載體
Nano-carriers for targeting cancer cells