

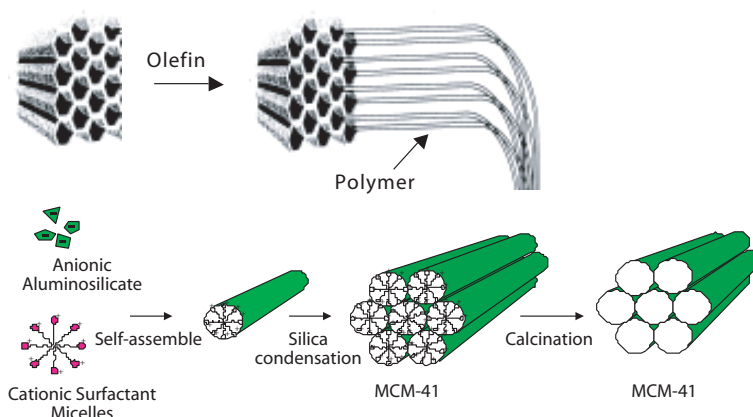
## Space-Confining Polymerization 介孔空間局限聚合反應技術開發

Polymerization in 2 to 10 nanometer nanopore reactors with appropriate catalysts can produce linear polymers with ultrahigh molecular weights and strengths. The polyethylene (PE) fibers thus produced at ITRI laboratories have recorded molecular weight greater than 7 million with melting temperatures greater than 140°C and a strength suitable for bulletproof applications. By putting different catalysts in the pores, molecular-level blending of two different polymers, such as aPS and sPS, was first demonstrated in the world.

以規則排列的2~10奈米孔洞作為奈米級反應器，可產出長鏈高分子聚合物，具有超高分子量及強度。工研院利用此種方法製作的聚乙烯纖維其分子量可達700萬，熔點高於140°C，其強度可作為防彈方面的應用。此外，經由同時加入不同的觸媒，工研院已領先世界達成兩種高分子如aPS及sPS奈米等級之混摻。

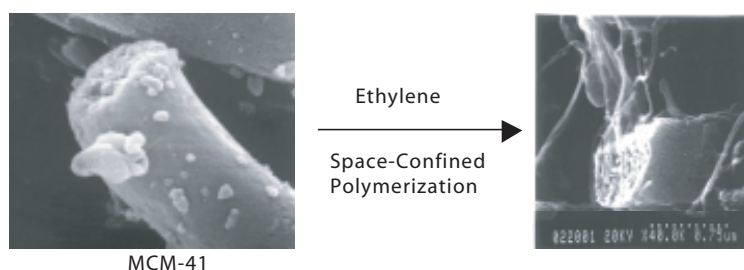
### Mesoporous Support

- High surface area (>1000 m<sup>2</sup>/g)
- Tunable pore size (20Å-120Å)

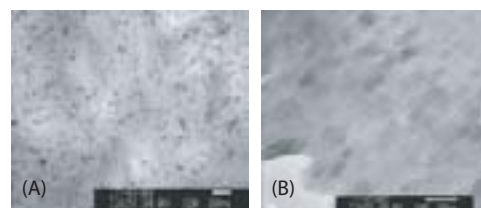
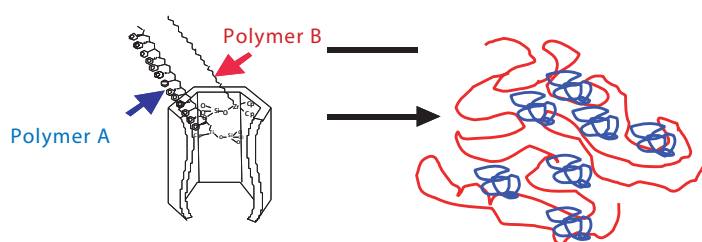


### Homopolymerization of PE

- Ultra high crystallinity ( $T_m > 140^\circ\text{C}$ )
  - Less branching
- Ultra high Mw ( $M_w > 7$  million)
  - Less chain transfer/termination



### Nano-Blending by Direct Polymerization



PE/aPS PE/sPS  
TEM micrographs of (A) aPS or (B) sPS (dark part) in PE matrix

### Advantages

- Existing polymer with controlled morphology and improved properties
- Nano-blended polymers from direct polymerization reaction without compatibilizer
- Polymers with well-dispersed inorganic particles to make composite material