

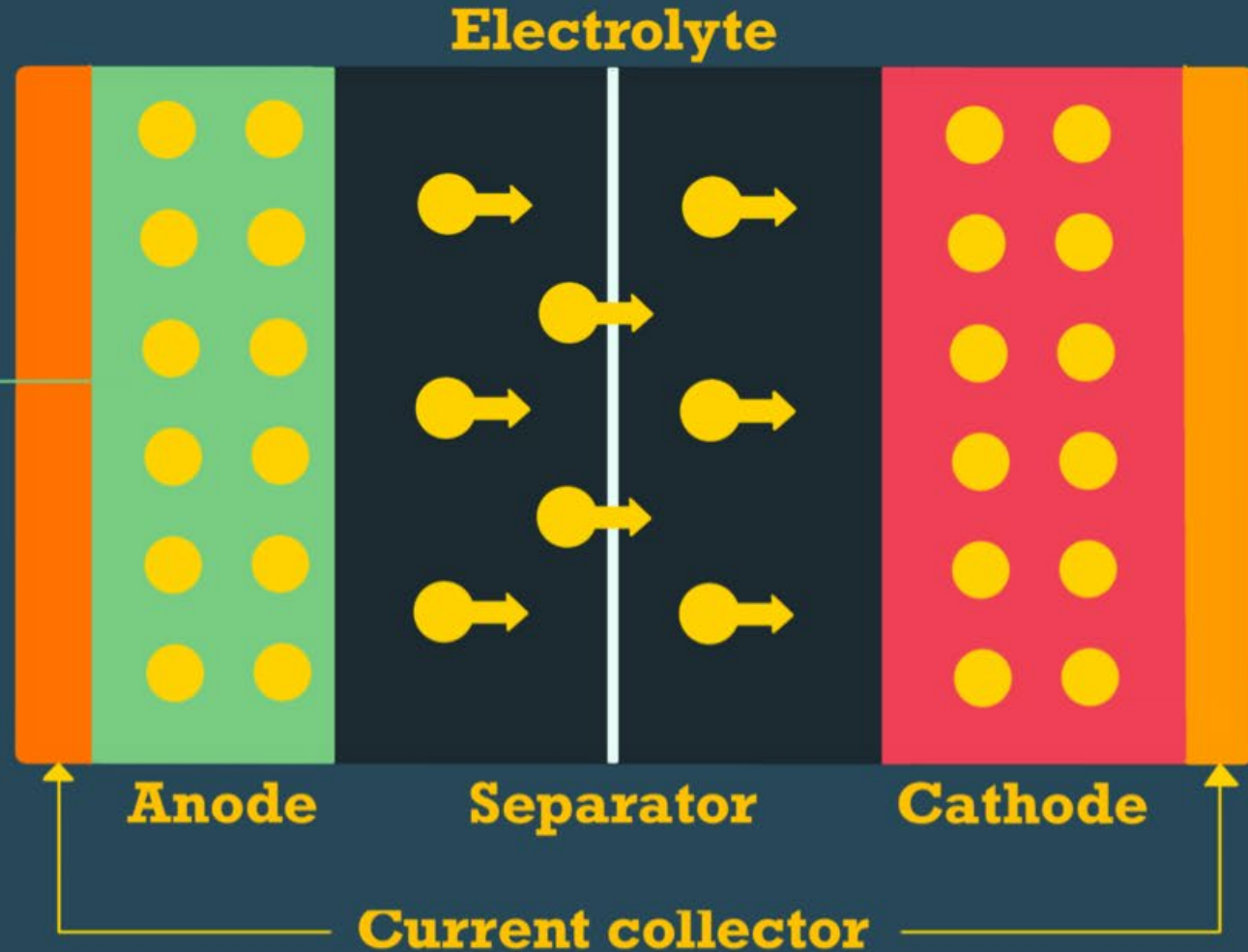
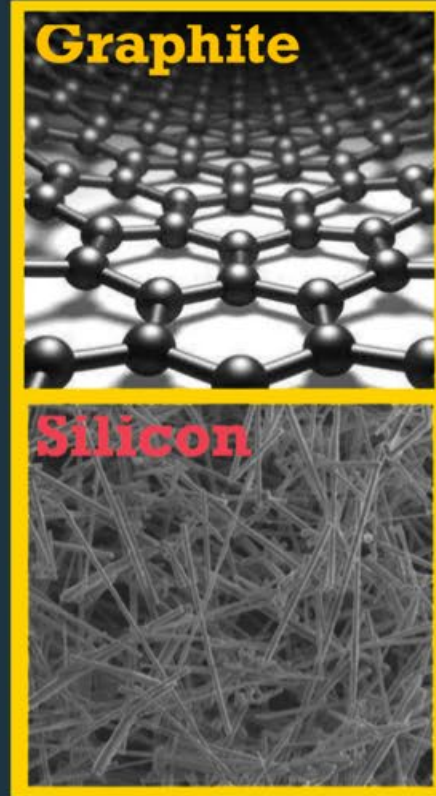
A graphic featuring a blue background with a hexagonal pattern on the left. Three yellow spheres with diagonal line patterns are positioned on the left, with several parallel yellow lines radiating from them towards the right. The word "Nanotechnology" is written in large, bold, yellow letters on the right side of the image.

# Nanotechnology

What does it have to offer the field of electric vehicles  
**materials & batteries**

**Challenges in the development of Si anodes for lithium-ion battery**

# Lithium-ion Cell



# Silicon's promise

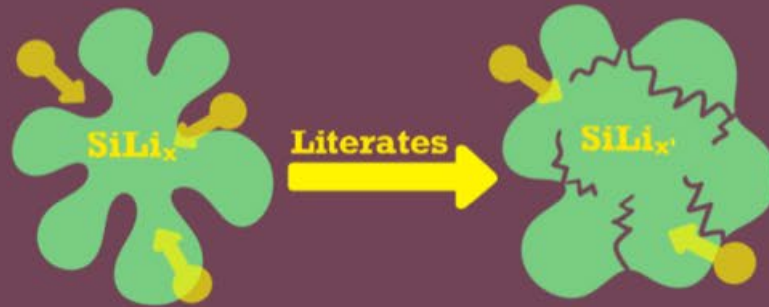


Each silicon atom can hold **4.4** lithium ion

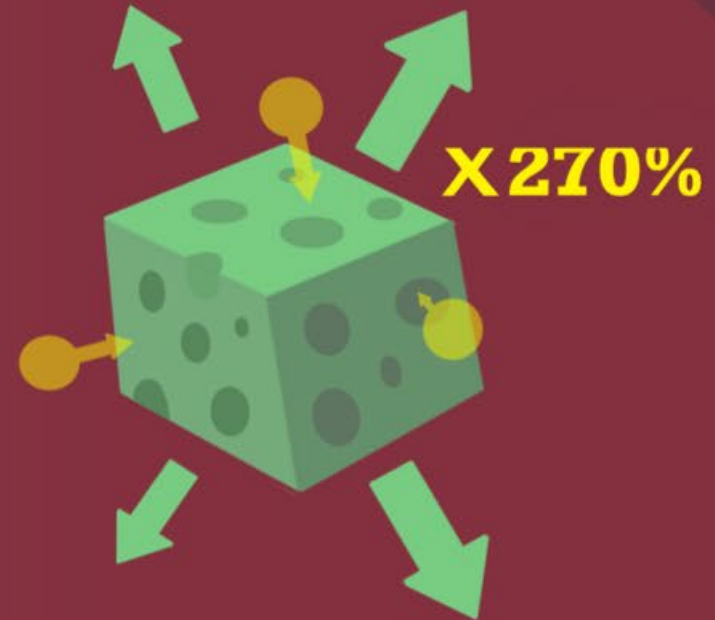
**3** Growth of SEI films



**2** Easy to fracture



**1** Easy to inflate



# Progress on silicon-based anode materials for particle lithium-ion battery

**Si**

**Si abundance:** 27.71 %  
**Working voltage:** ~0.4V  
**Theoretical capacity:** ~4200mAh/g

**Si/graphite composites**

**Industrial perspective**

**Si content**

**Initial CE**

**Pressing density**

**Si or SiO<sub>x</sub>**

**Pre-lithiation**

**Areal capacity**

**Toward next generation Si-based anode**

**Nanoparticles**

**Nanowires**

**Nanotubes**

**Fundamental view**

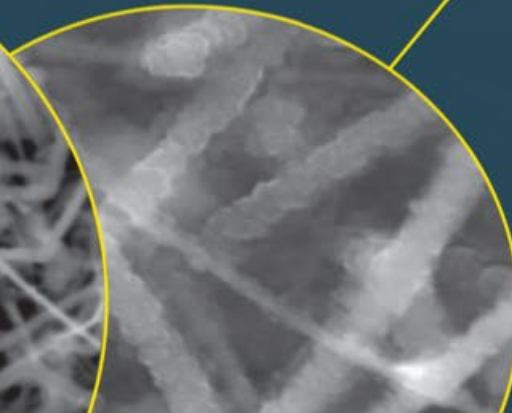
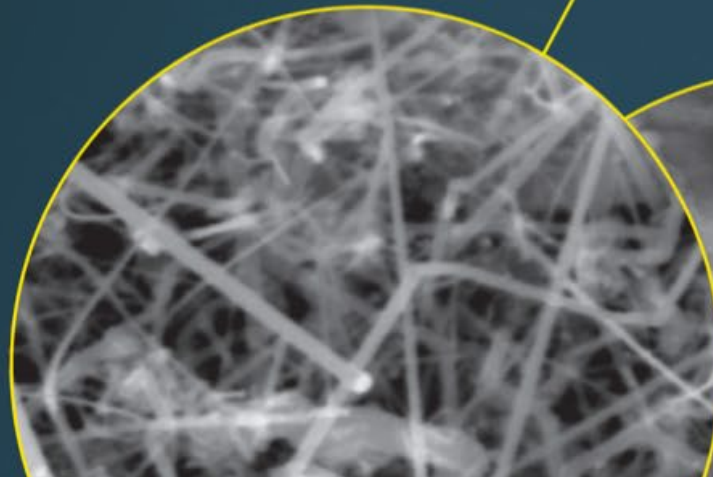
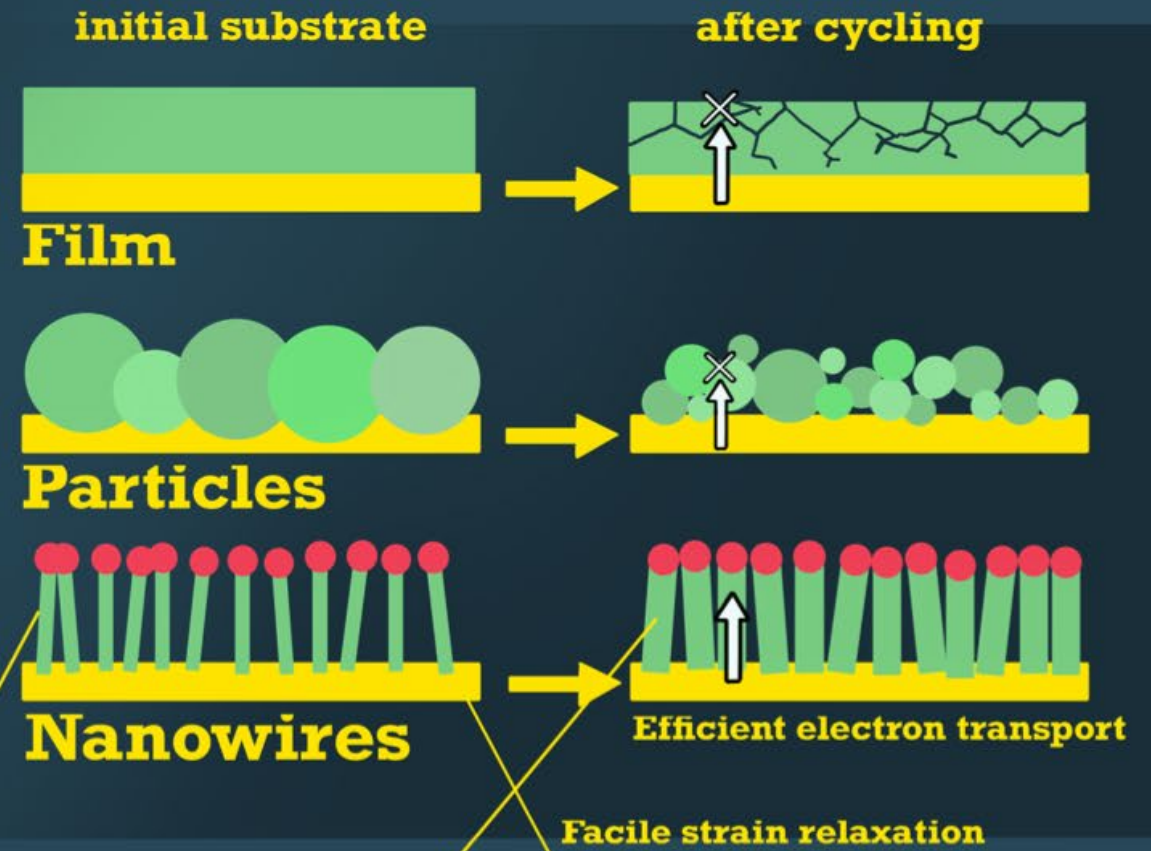
**Nano-Si design**

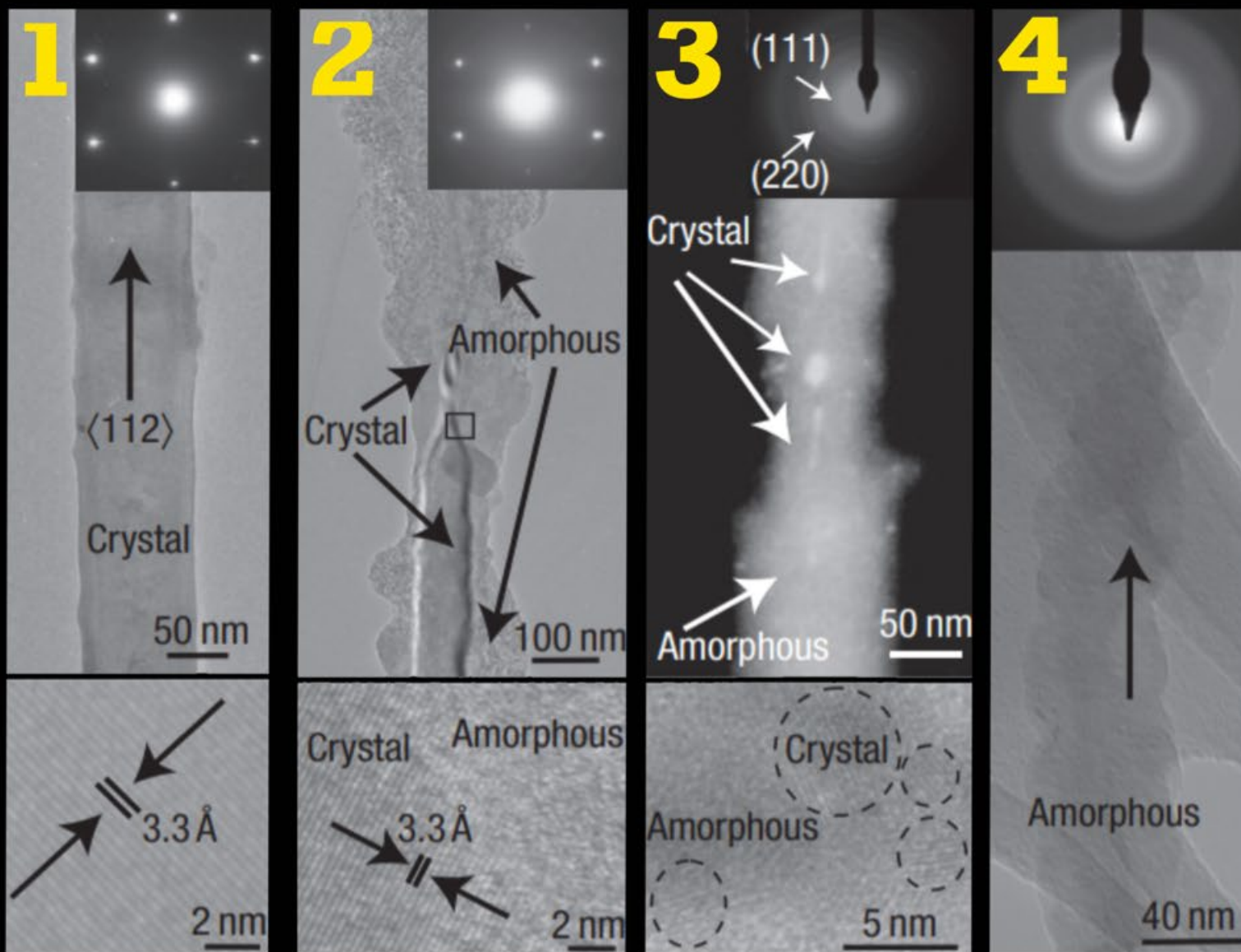
**Hollow**

**Core/shell**

**Yolk/shell**

# Why silicon nanowires



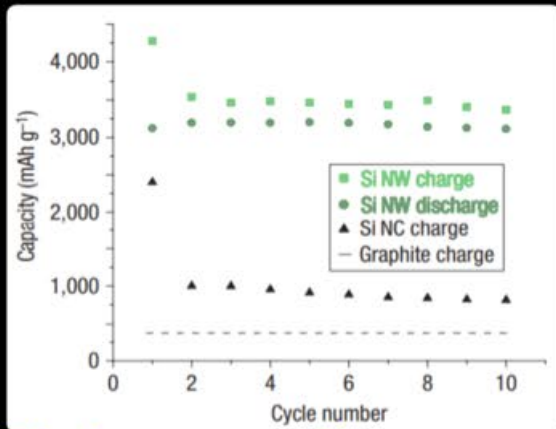


# How silicon nanowires work

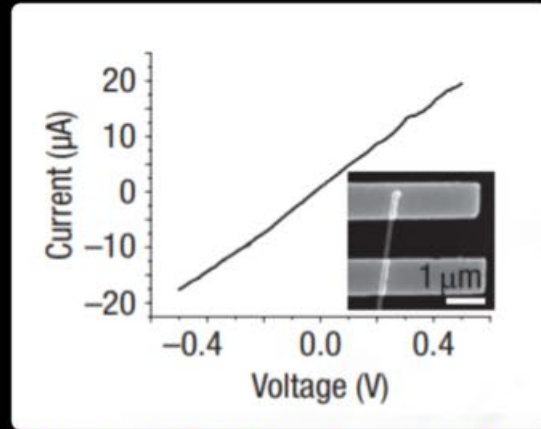
**Structural evolution of Si NWs during lithiation**

# Silicon nanowires

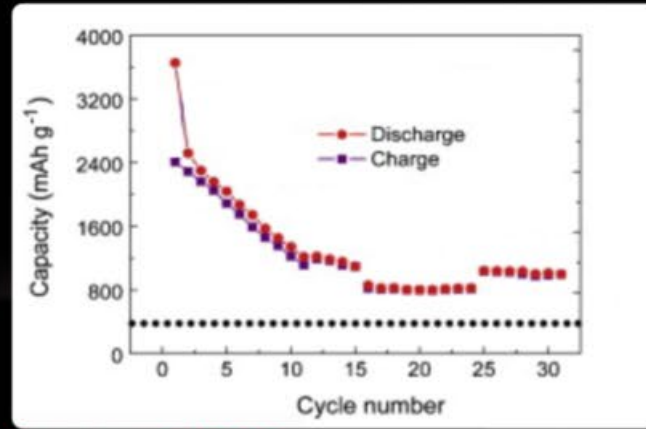
## advantage and disadvantage



**The larger capacity**



**Efficient electron transport**



**Less cycle life**



**Graphite(372mAh/kg)  
75000/ton**

**Graphite + SiNWs(435mAh/kg)  
120000/ton**

**Higher manufacturing costs**



# Improvement of silicon nanowires

