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What “wastes”?  

**Plastic wastes**  
“Plastic bags: top 50 worst inventions” ---- Time magazine

**Construction wastes**  
“In 2013, 1 billion metric tons of construction wastes... 5% of them were recycled...” ---- China Daily

**Recycled materials**  
Or “down cycled” and get looked down on?
Current ways to deal with these wastes...

Plastic wastes

Construction wastes

Recycled materials

Can we make better use of wastes?
Question: How to make wastes useful?

HINTS:
1. Plastic wastes: LDPE, HDPE, PVC, EVA... ductile and extensible, but low on stiffness and strength
2. Construction wastes: ceramics and glasses... stiff and strong, but low on toughness
Nature is a Master at recycling materials and sustainable construction

Stiff but brittle minerals (aragonite: used to make chalks)

Ductile yet weak organic compounds (amino acids, proteins...)

Super tough bio-ceramic: mollusk shells

3000 times amplification on toughness
Property amplification in biological materials

- Nacre
- Conch shell
- Tooth enamel

A diagram illustrating the toughness vs. stiffness of various biological materials, with a focus on bioinspired materials like nacre and tooth enamel.
How do biological materials achieve these properties?

KEY FEATURES:
1. Complex and well-designed architectures made of weak constituents
2. Stiff and hard building blocks, and ductile organic interfaces
The concept of architectured materials

- Stiff material
- Ductile material
The concept of architectured materials

- Stiff material
- Ductile material
- Voigt model
- Reuss model
The concept of architectured materials

- Stiff material
- Voigt model
- Architectured material
- Reuss model
- Ductile material

Force vs. Deformation

Energy absorption (Toughness)
WHAT PROPERLY-DESIGNED ARCHITECTURES SHOULD GENERALLY DO:

1. Use each ingredient to their full potential
2. Exploit synergies of performance between dissimilar constituents
Bioinspired architectured materials: A promising way to turn “wastes” into valuable materials
The design and fabrication of high performance architectured materials from relatively weak constituents (glasses or ceramics, and polymers like LDPE, EVA, PU…)

Our current research

Our next stage

Construction wastes
Plastic wastes
Recycled materials

Fabrication and tests of architectured materials directly made of wastes or recycled materials (rubbles, LDPE and EVA bags…)

Our aspiration!

Architectured materials made of wasted or recycled sources ready for high value applications

We are here!
Thank you. Stay in touch.

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