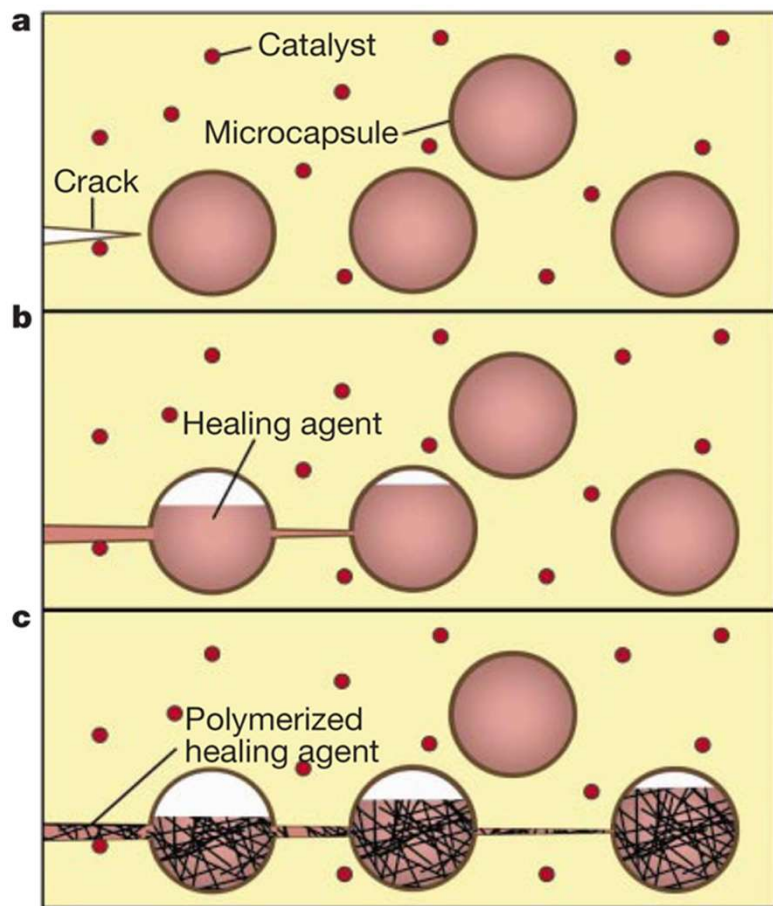


Self-healing Materials

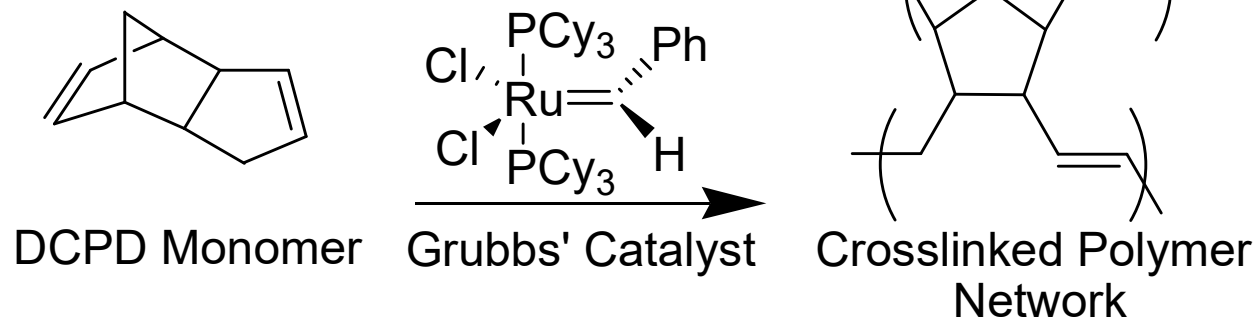
Self-healing can be defined as the ability of a material to heal damages automatically and autonomously, that is, without any external intervention.

- Autonomic (without any intervention)
 - Release of healing agent
 - Microcapsule embedment
 - Hollow fiber embedment
 - Microvascular systems
 - Nonautonomic (needs an external trigger)
 - Reversible cross-links
 - Reversible cycloaddition reactions
 - Ionomers
 - Supramolecular polymers
-

Self-healing via Microsphere Embedment



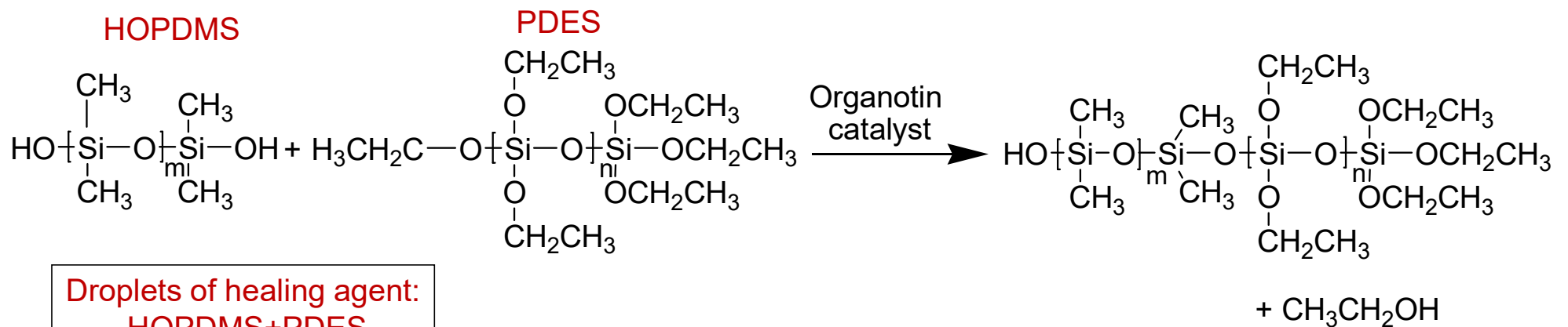
☺ Autonomic healing



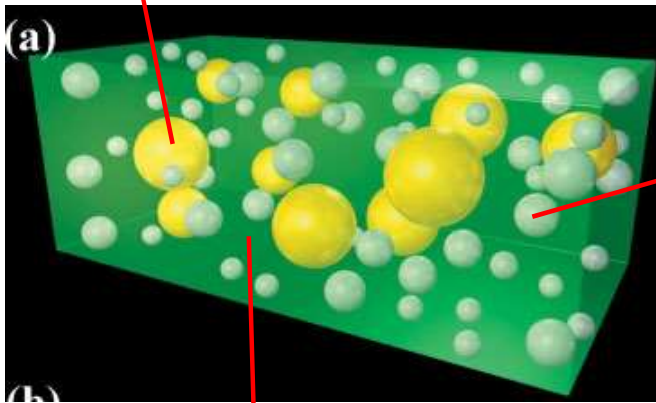
☹ Multiple healing impossible

White et. al. *Nature* **2001**, 409, 794.

Dual Capsule System



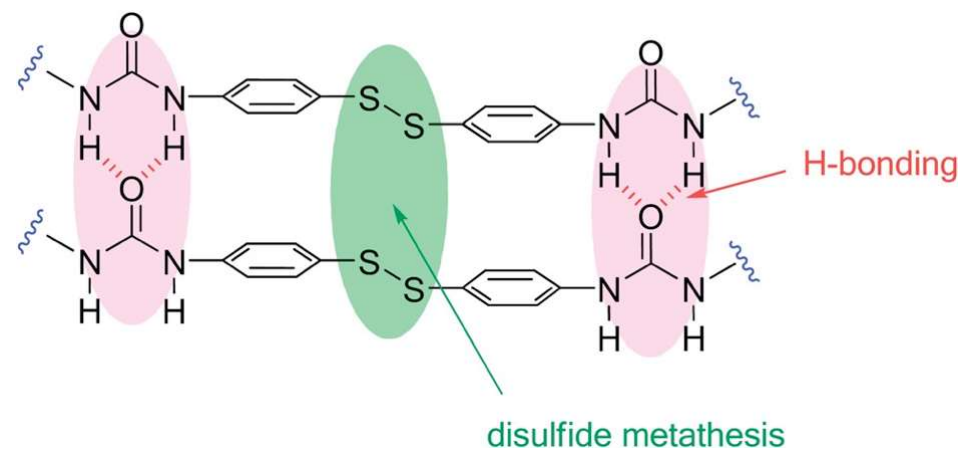
Droplets of healing agent:
HOPDMS+PDES



Catalyst: di-*n*-butyltin dilaurate (DBTL), encapsulated in polyurethane microcapsules

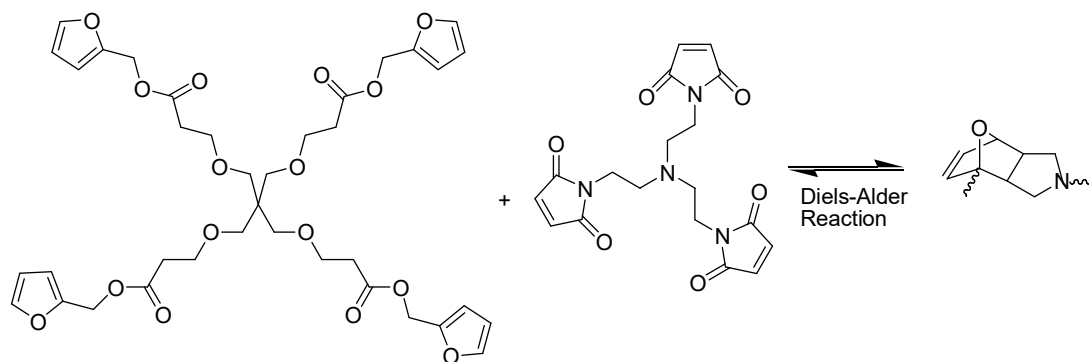
Vinyl ester matrix

Catalyst free, Room-temp. Self-healing Elastomer



Rekondo et.al. *Mater. Horiz.*, **2014**, 1, 237.

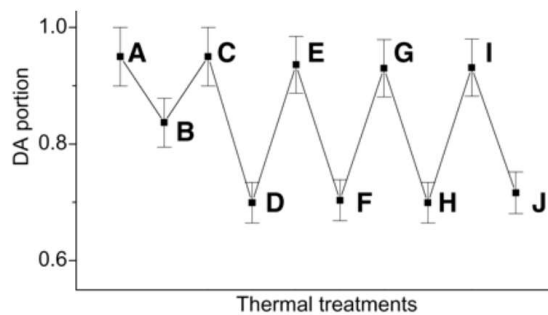
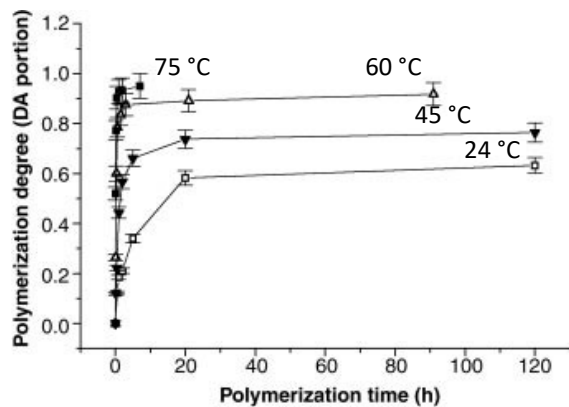
Thermally Cross-linked Self-healing Materials



Multifuran

Multi-maleimide

Highly crosslinked
Polymer network



- Multiple cycles of autonomic crack mending
- Uncatalyzed thermal treatment

Smart, Self-healing Coating

Scratch Resistant Self-healing Coating



New scratches



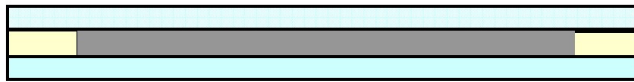
One week later

TOKYO (Dec. 2, 2005)-- Nissan Motor Co., Ltd

Photovoltaic Devices: Challenges





Protection from moisture / oxygen is needed

Edge Sealant



Laminating Adhesive



-  : substrate
-  : adhesive
-  : display media
-  : inorganic coating

Polymers used: silicones, epoxies, polyurethanes, acrylates, fluorine containing polymers, etc.

Drawback

- Insufficient barrier properties
- Insufficient oxidative, thermal and UV stability

Objective

To develop self-healing sealant with high barrier properties and stability