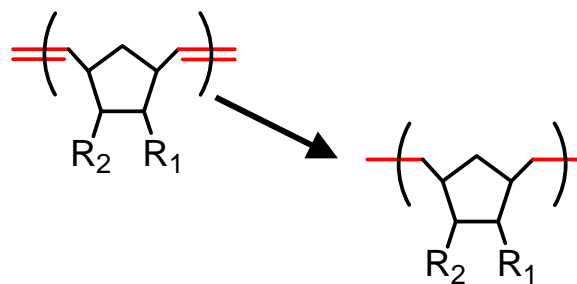
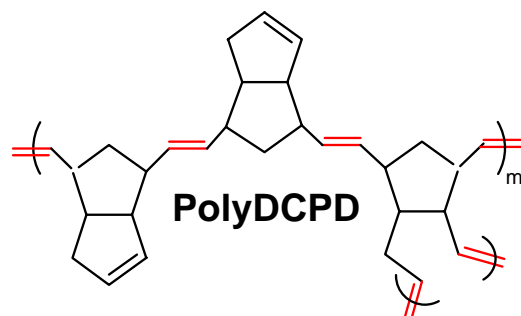
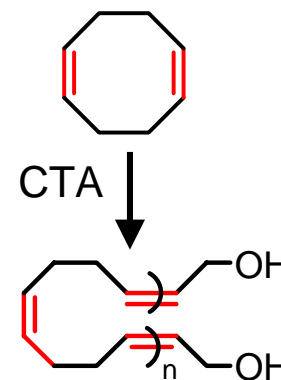
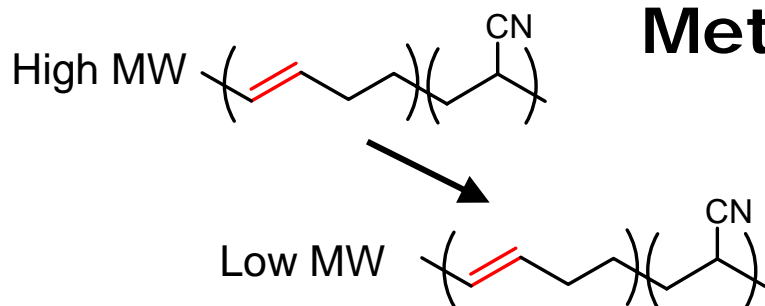


New Materials via Robust Metathesis Catalysts: Optimizing Properties in PolyDCPD Composites

Brian Edgecombe, Sr. Research Scientist
Materials R&D
Materia, Inc.



Olefin Metathesis



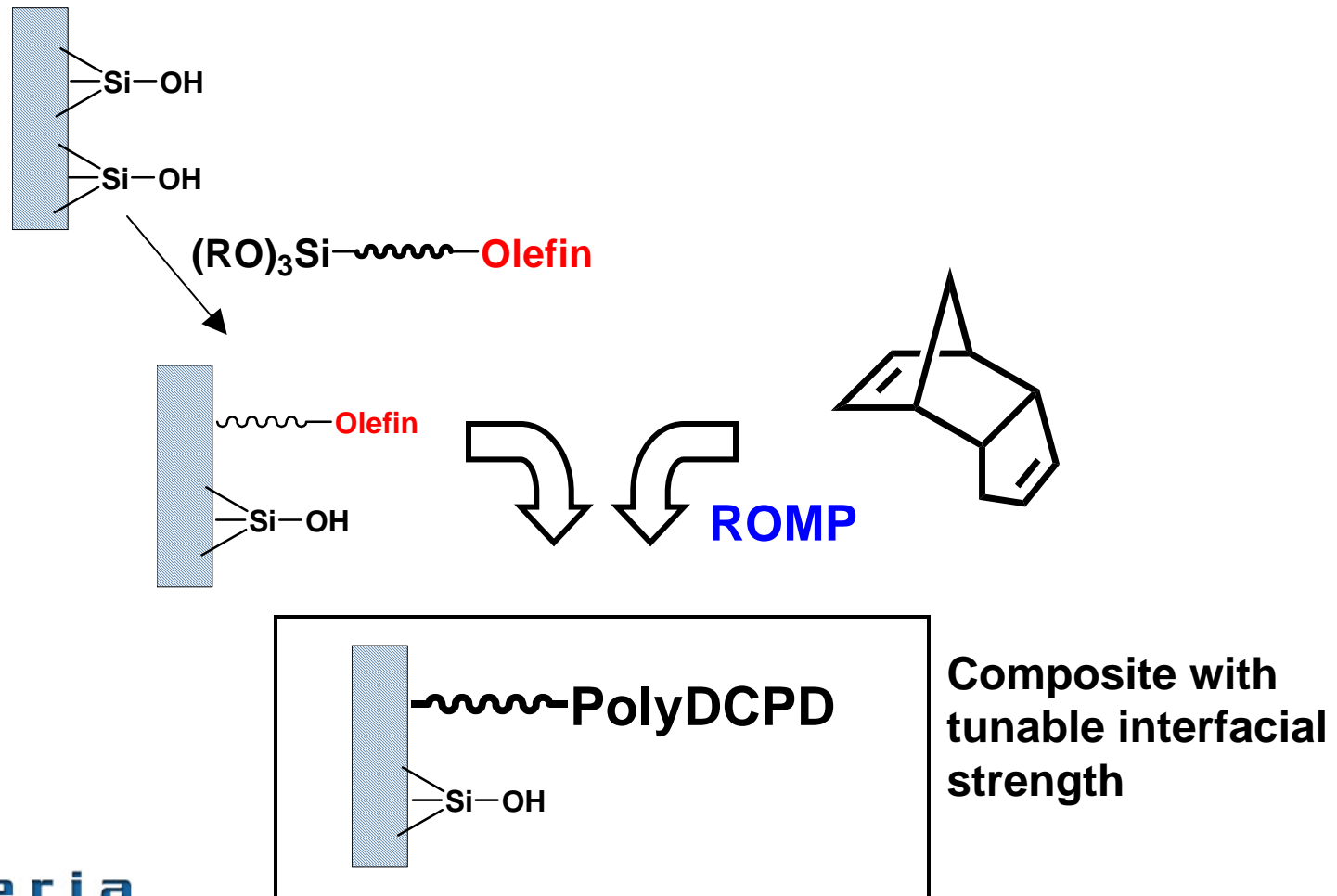
**Materia's catalyst technology is an enabler for
materials-based products with unique sets of properties**

Background: Competitive Advantages of PolyDCPD with Materia Catalysts

- **Ease of handling, formulation, processing**
 - Air / water stable (as solids)
 - Tolerant of fillers, additives, many functional monomers
- **Excellent physical and mechanical properties**
 - High HDT (130 – 190°C)
 - Competitive strength / modulus and excellent toughness
 - Excellent capability with painting / in-mold-coating
- **Controlled viscosity: very low to high viscosity (5-2000 cP)**
- **Cure times from seconds to several hours**
- **Ideal resin for many processes: RIM, RTM, VARTM, rotational molding, centrifugal casting, filament winding, and pultrusion**

Surface Optimization of Glass Fiber for PolyDCPD

Optimization of the Glass surface in order to optimize the PolyDCPD composite system

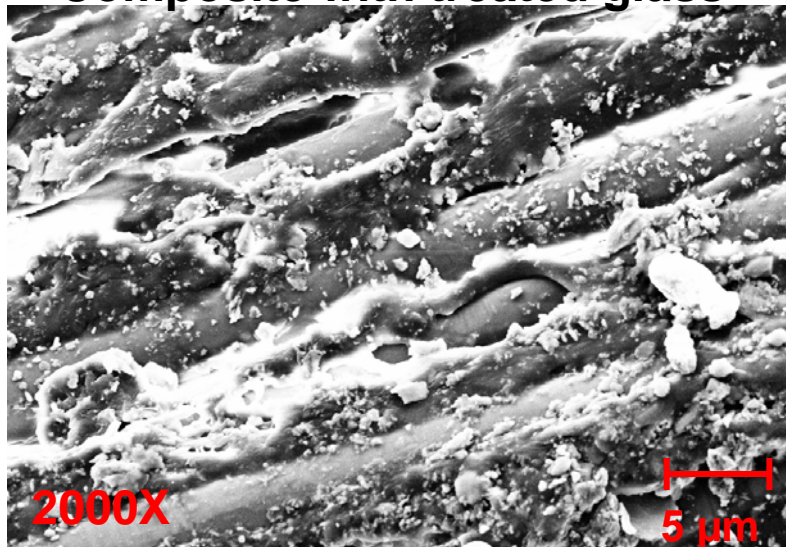


Control of the Glass-PolyDCPD Interface

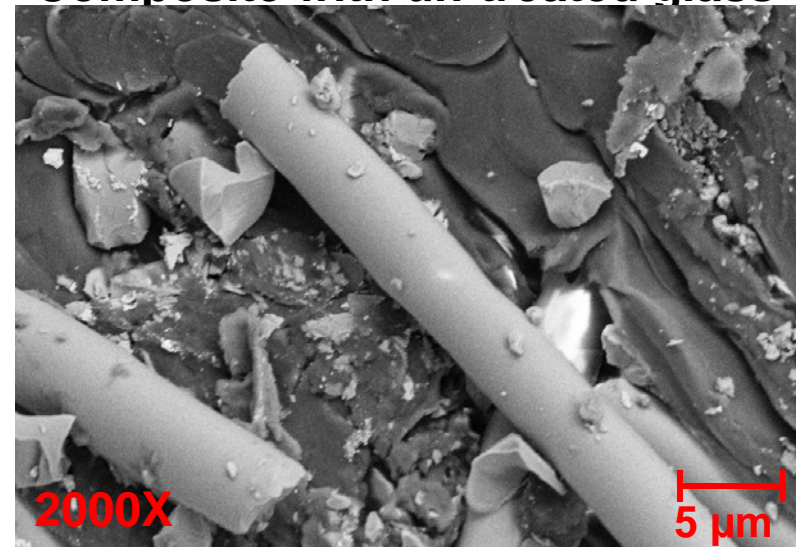
Transparency and fracture surfaces suggest good interaction between fiber and resin for treated glasses



Composite with treated glass



Composite with un-treated glass



Effect of Glass Treatments: Metathesis-Active Silanes

| No. | Silane | Fiber Vol. % | Flex Peak Stress | Flex Mod. | Norm. Flex. Peak Stress | Norm. Flex Mod. |
|-----|------------------------|--------------|------------------|-----------|-------------------------|-----------------|
| | # | % | ksi | ksi | ksi | ksi |
| 1 | None | 45 | 34 | 2300 | 38 | 2600 |
| 2 | Allyl Triethoxy Silane | 48 | 53 | 2700 | 55 | 2800 |
| 3 | Proprietary Silane | 47 | 82 | 3200 | 87 | 3400 |

*Data normalized to 50 vol. % of glass fiber for comparison
Composites prepared via VARTM process
All Fabrics sized in aqueous silane solution

By controlling interactions at the PolyDCPD / glass interface, property differences are observed.

Effect of Functional Additives in Syntactic Foam

Can lessons from glass fiber be extended to this area ?

Yes, mediation of glass/DCPD interface via additives yields improved properties



| Notebook # | Glass | Additive 1 | Cure | Comp. Peak | Comp. Modulus | Density |
|--------------|-------|------------|------|------------|---------------|-------------|
| | | | | ksi | ksi | lbs./cu.ft. |
| JR152-168A | S15 | none | 30°C | 4.2 | 158 | 36.3 |
| BB170-046-A3 | S15 | Additive A | 30°C | 5.3 | 176 | 36.8 |
| JR152-189 | K25 | Additive A | 30°C | 7.3 | 250 | 36.7 |

* 36 lbs/cu.ft = 0.59 g/cc