



DOW

®

ENCAPSULATION MATERIALS: WHY TALK ABOUT POLYMERS AT THE MIW?

12th Metallization and Interconnection Workshop

October 2024

Caroline Grand, Yuyan Li, Guy Beaucarne

Dow has a diverse product offering, backed by material science expertise and a global production footprint

Global leader in POE technology and production



Europe, the Middle East, Africa & India

U.S. & Canada

Asia Pacific

Differentiated silicone products for PV applications



Electronic encapsulants

Potting agent

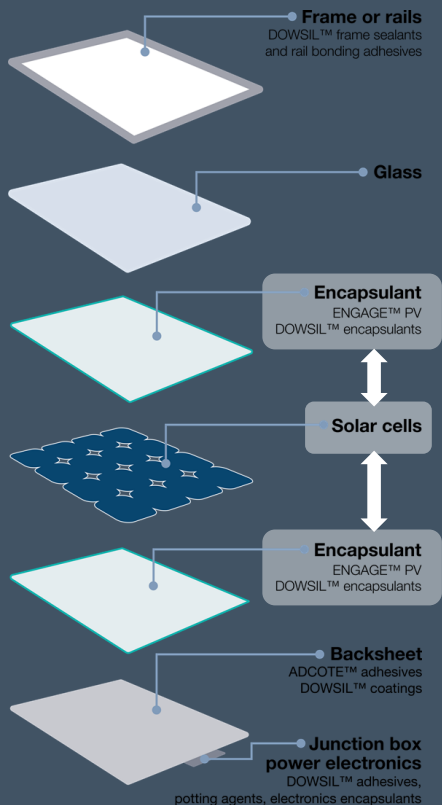
Silicone Sealant

Latin America

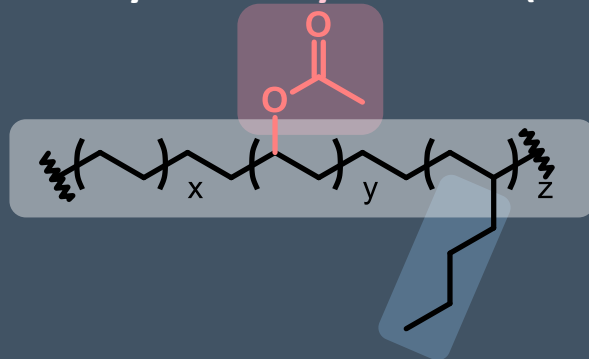
98 manufacturing sites in 31 countries
16 Innovation Centers in 10 countries



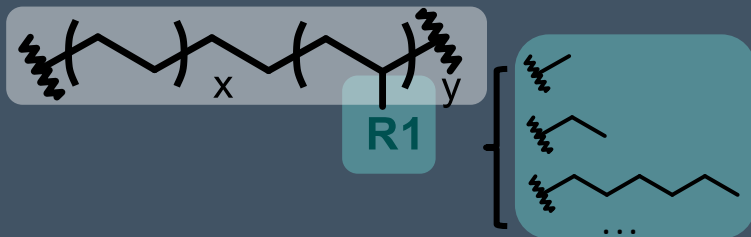
Understanding encapsulant materials is key for metallization and interconnection interface



Ethylene-Vinyl Acetate (EVA)



Polyolefin Elastomer (POE)



Not all encapsulants labeled as “POE” contain a POE resin: Non-polar structure is what differentiates POE from other resins

Ethylene-based polymers

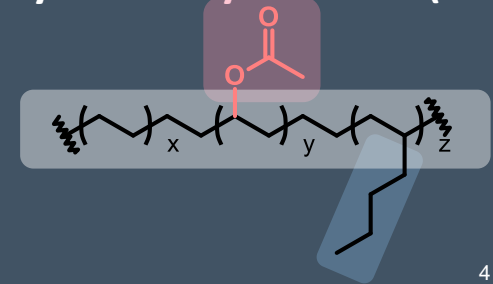
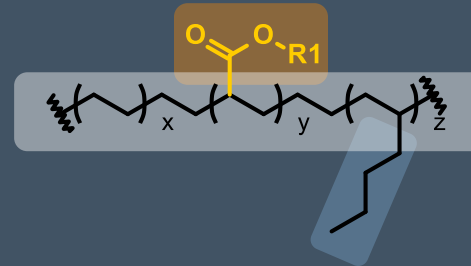
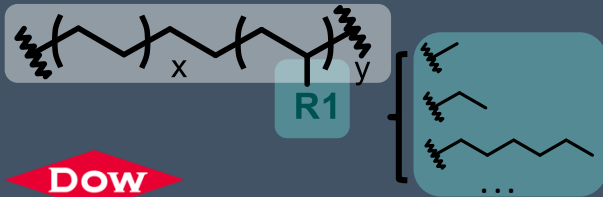
Polyolefins (PO)

Ethylene **polar** copolymers

Polyolefin Elastomer (POE)

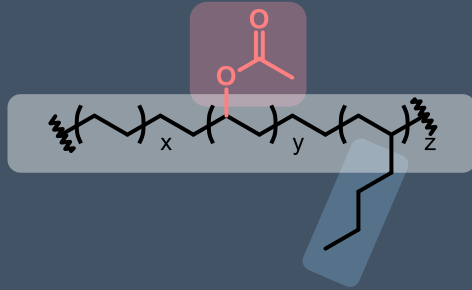
Ethylene-Acrylate

Ethylene-Vinyl Acetate (EVA)



Polar and reactive unit from EVA as root cause for corrosion

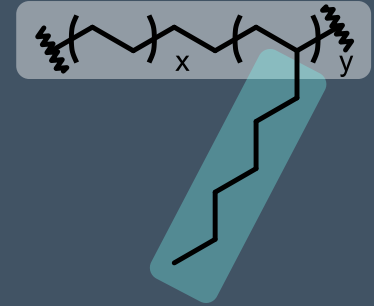
Moisture ingress, ionic conductivity of Na⁺



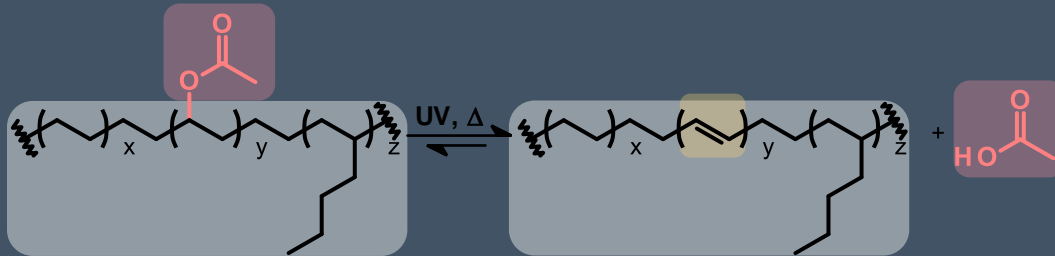
WVTR, 38 °C, 100% RH

34 g/(m²·day)

3 g/(m²·day)



Acetic acid formation

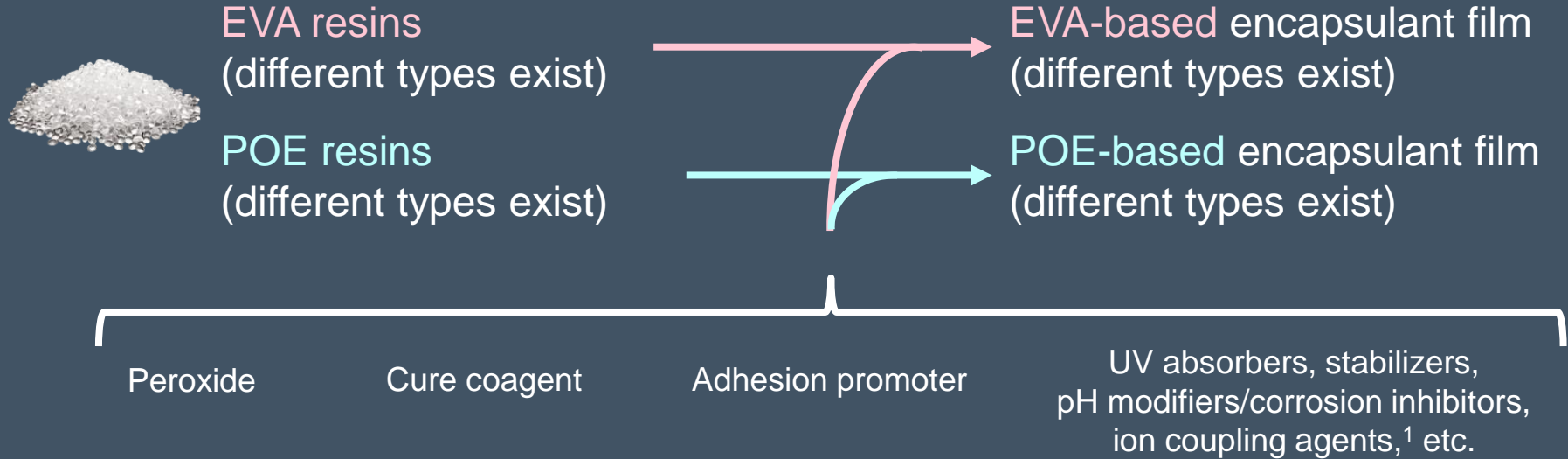


Corrosion of cells in a 15-year-old double-glass module in Hainan (Energy Magazine, 2016)



Klemchuk, P. *et al. Polym. Degrad. Stab.*, **1997**, 55, 347.
Thornton, P. *et al. Sol Energy Mat Sol C*, **2022**, 244,111818.

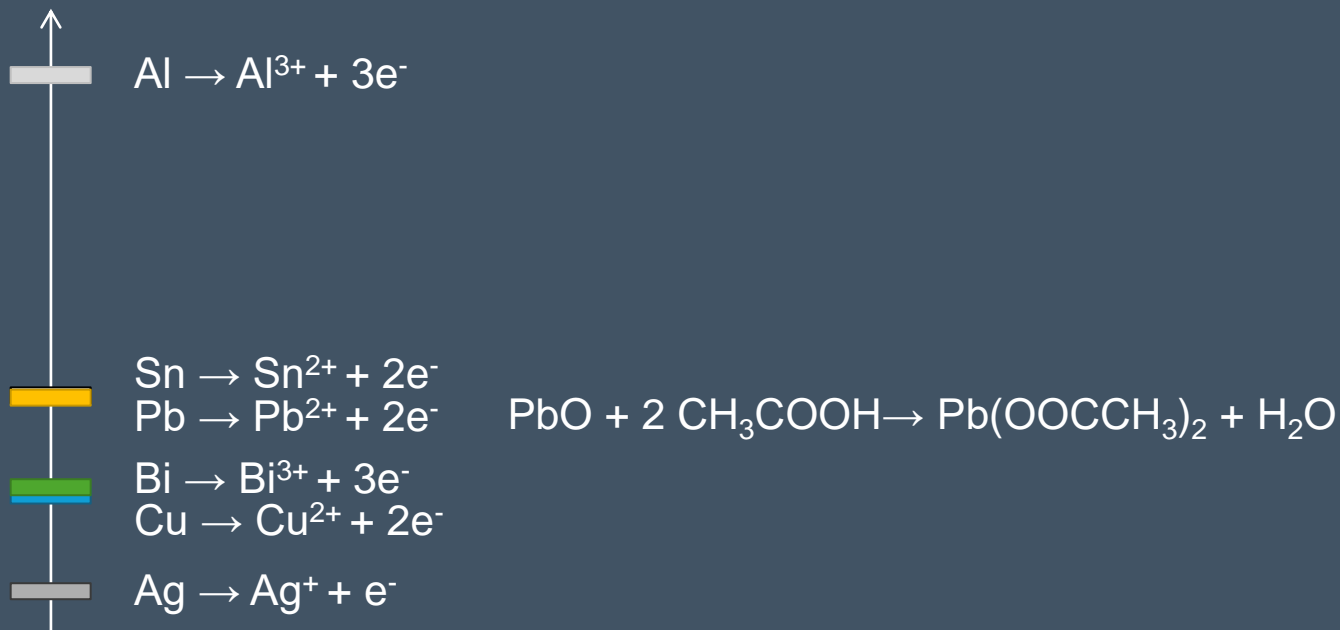
Warning: Vague nomenclature and additives present in encapsulant film can result in contradicting reported findings



1. Rudolph, D. *et al.* Sol Energ Mat Sol C, 2024, 264, 112603.

Reactivity of module components as one key factor for reliability

Relative E^0 , ease of oxidation



G. Milazzo *et al.*, *Tables of Standard Electrode Potentials*, Wiley, 1978.

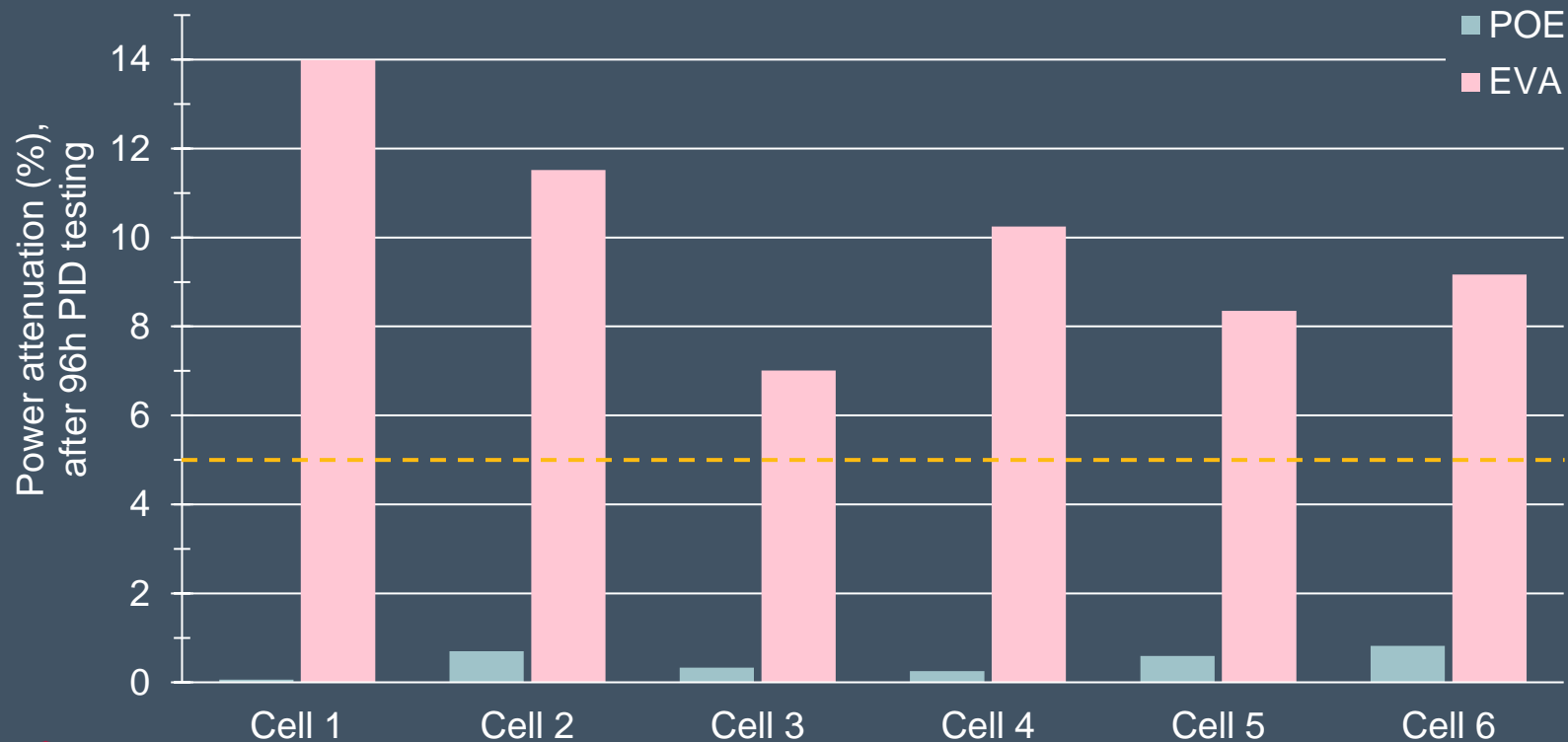
A. J. Bard *et al.*, *Standard Potentials in Aqueous Solutions*, Marcel Dekker, 1985.

S. G. Bratsch, *J. Phys. Chem. Ref. Data*, 18, 1-21, 1989.

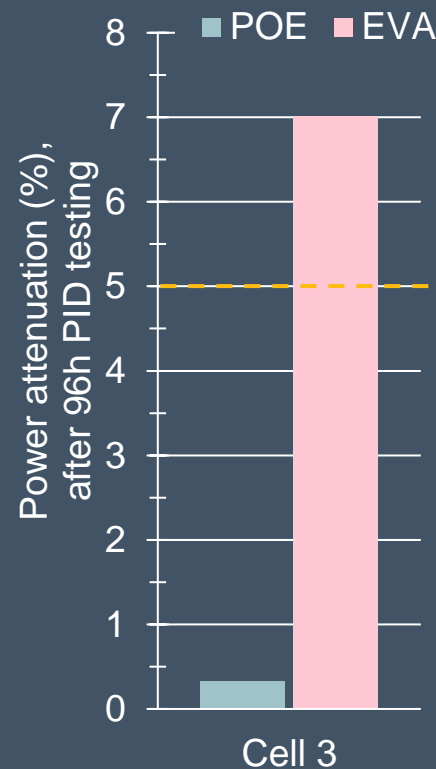
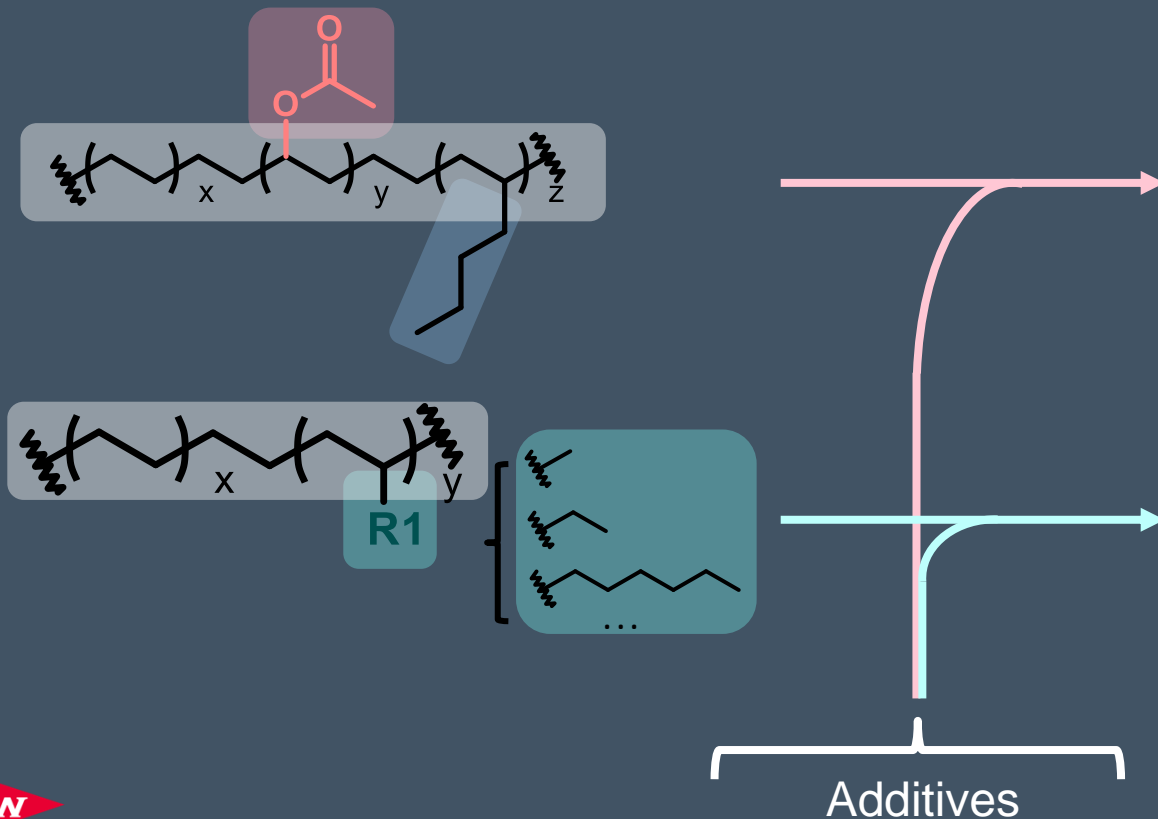
Kraft, A. *et al. IEEE Journal of Photovoltaics*, 2015, 5, 736



TOPCon cells with LECO treatment still benefit from POE-based encapsulants compared to EVA-based encapsulants



Key takeaway: Material understanding, whether inorganic or organic, is critical to studying module reliability





Thank you

Seek Together