



E-fuels beyond methanol and hydrocarbons: the E-TANDEM route to higher oxygenate Power-to-X fuels

Gonzalo Prieto

18th February 2026

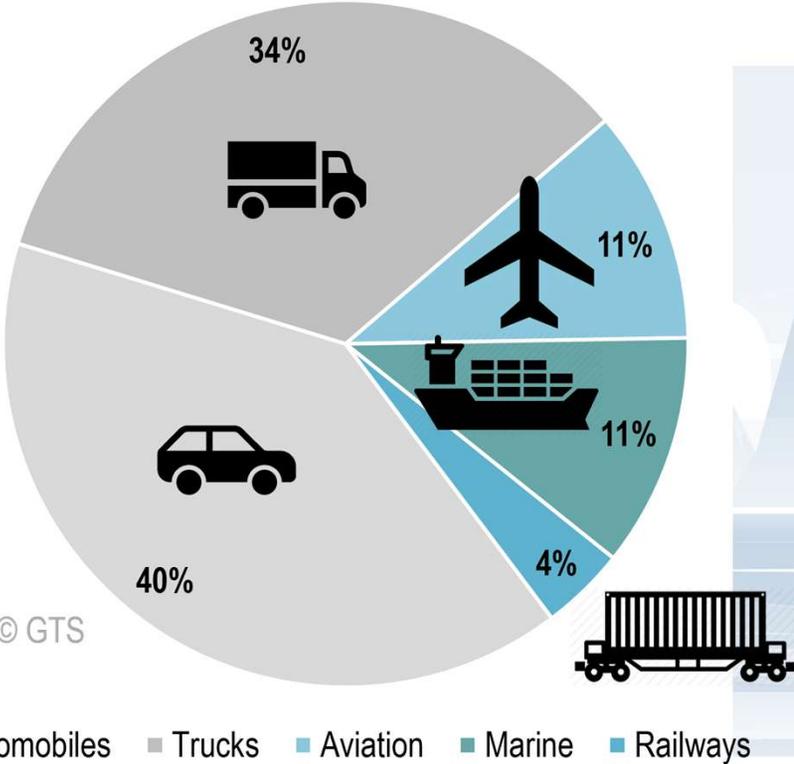


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Waterborne transport: a hard-to-abate sector



CO2 Emissions by the Transport Sector

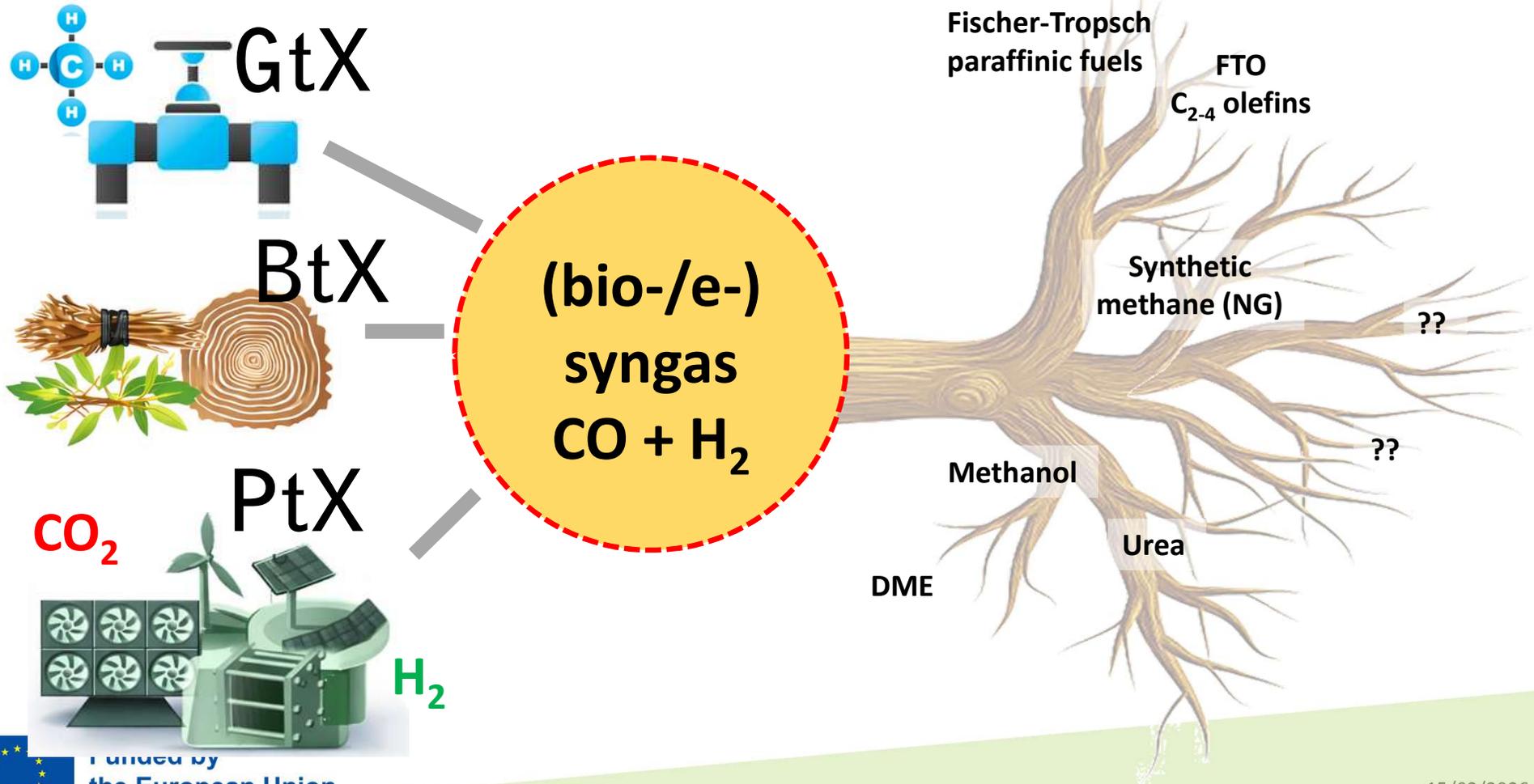


International Energy Association. IEA and IPCC (2014) Summary for Policymakers.

United Nations publication issued by the United Nations Conference on Trade and Development TD/STAT.49



Syngas: the versatile C_1 building block for e-fuels



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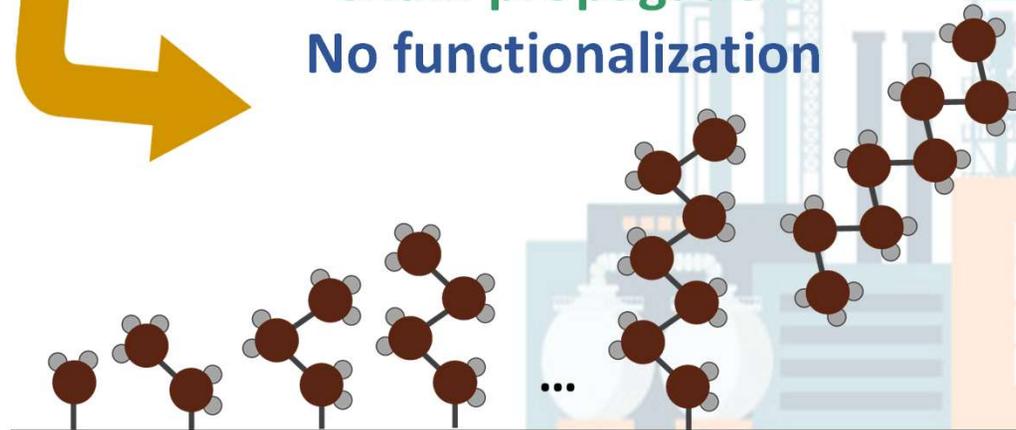
Syngas conversion catalysis: chain growth vs function

No chain propagation
Functionalization

Chain propagation
No functionalization

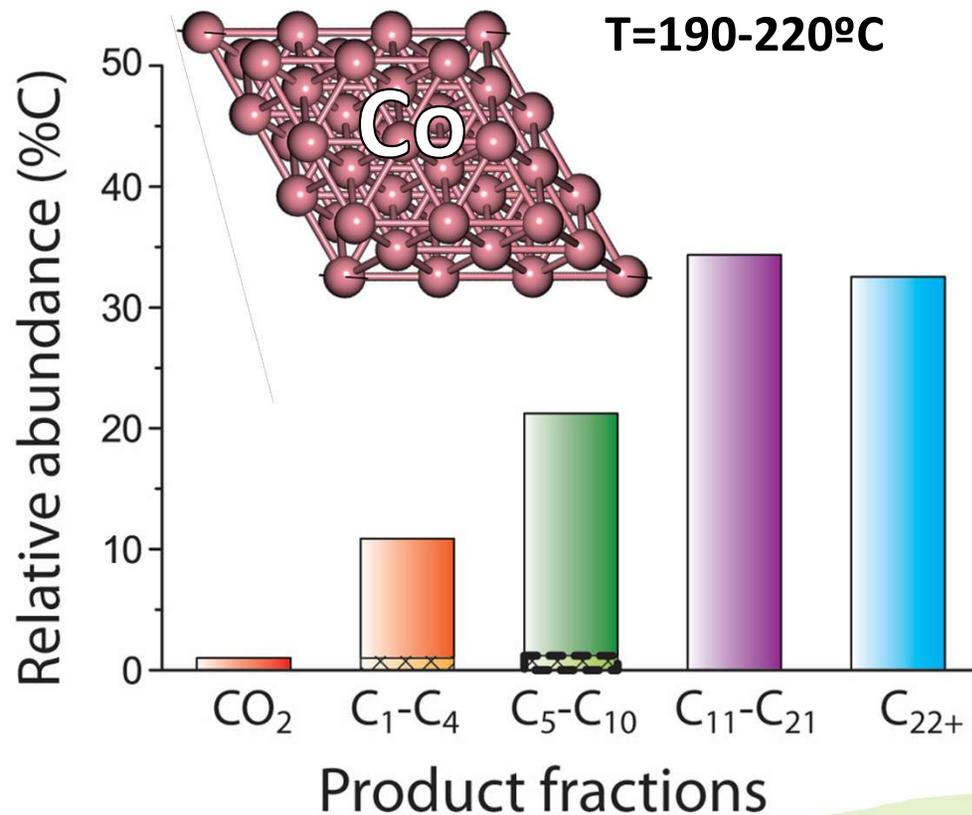
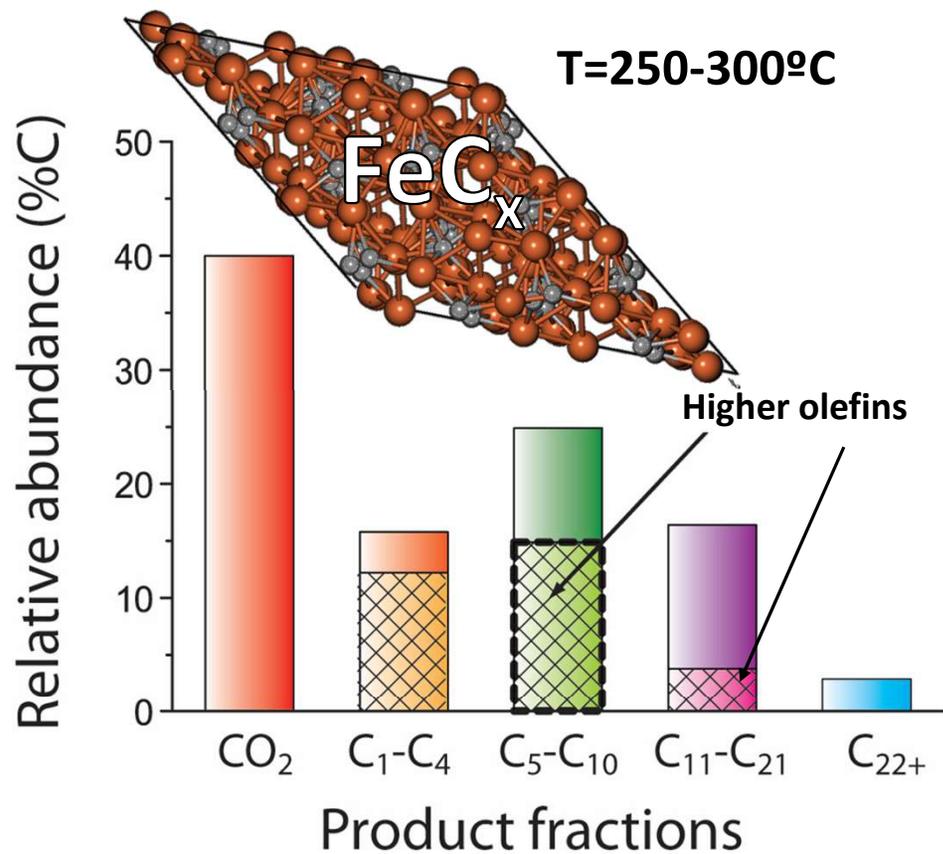


Methanol synthesis

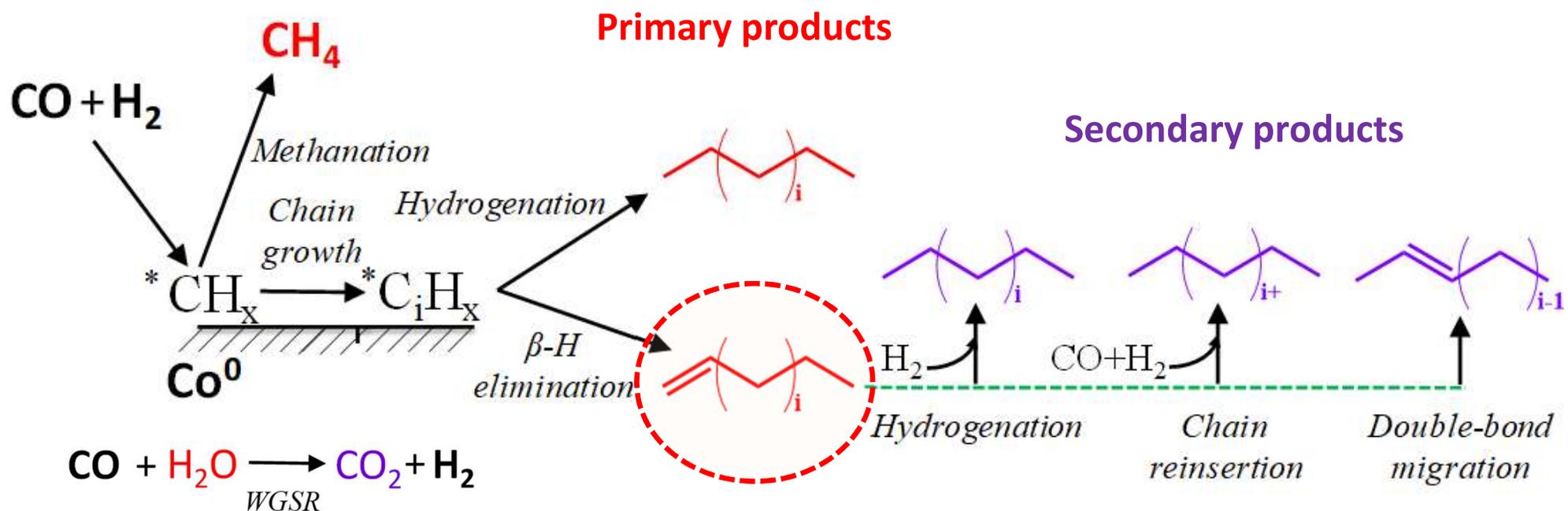


Fischer-Tropsch synthesis

Fischer-Tropsch synthesis



Fischer-Tropsch synthesis

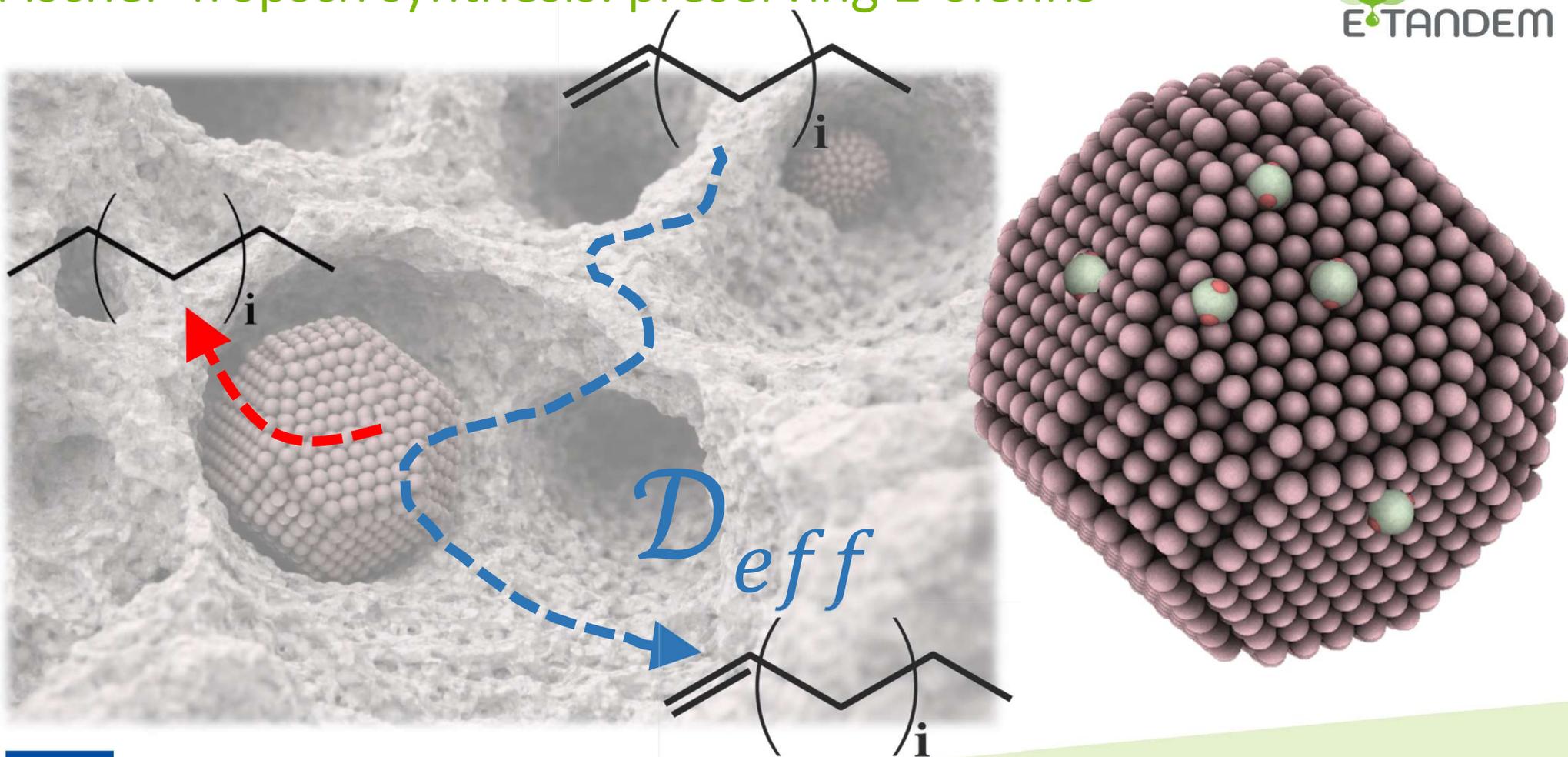


E. Iglesia, *Appl. Catalysis A: Gen* 161, 1997, 59-78.

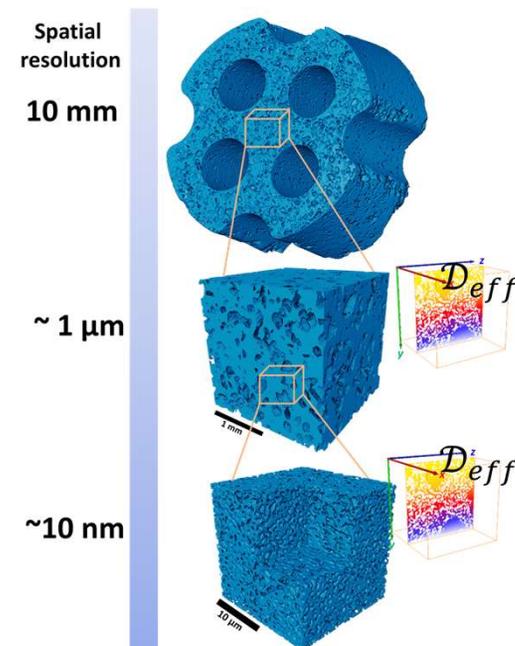
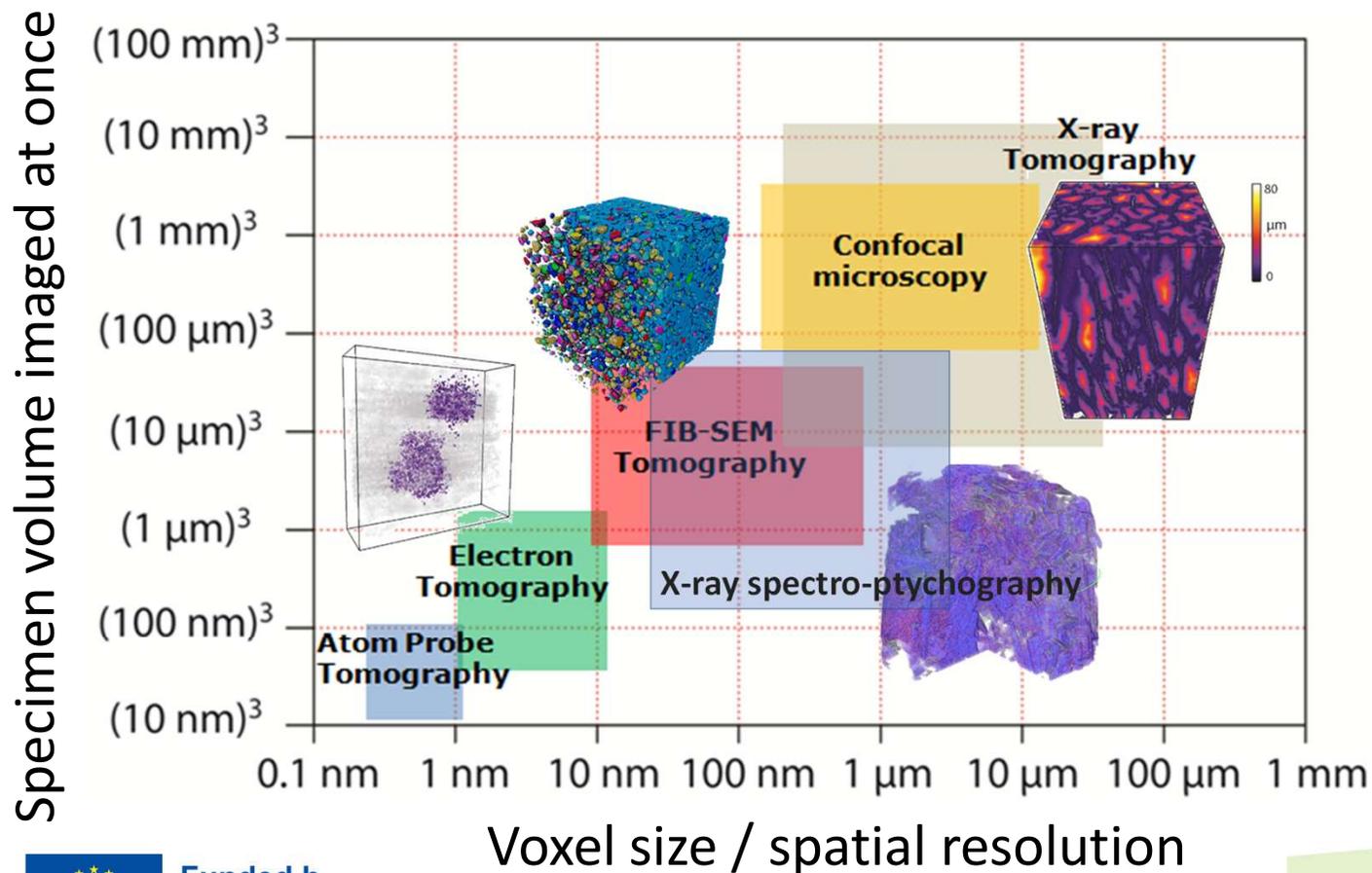


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Fischer-Tropsch synthesis: preserving 1-olefins



Solid catalyst design: tomographic imaging



Nature Materials, 12 (2013) 34-39

Nature Materials, 14 (2015) 48-55.

Angew. Chem. Int. Ed. 54 (2015), 11804.

Angew. Chem. Int. Ed. 56 (2017) 11480.

ACS Catal. 11 (2021) 4784.

Angew. Chem. Int. Ed. (2022) e202201004.

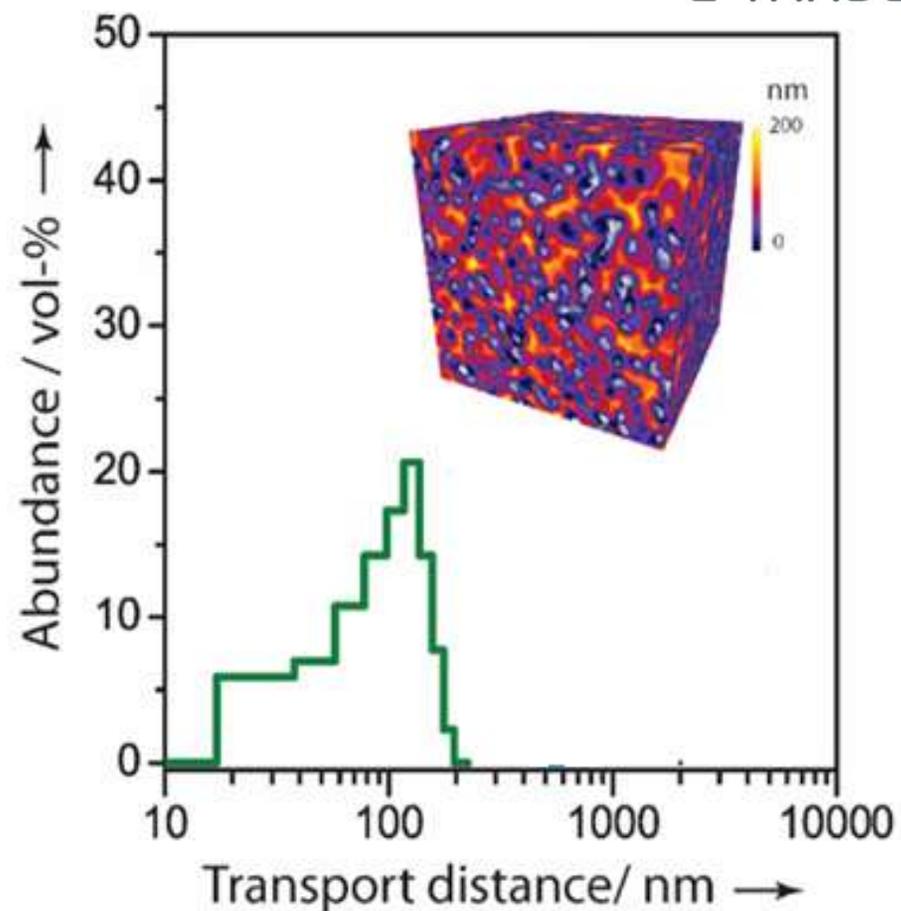
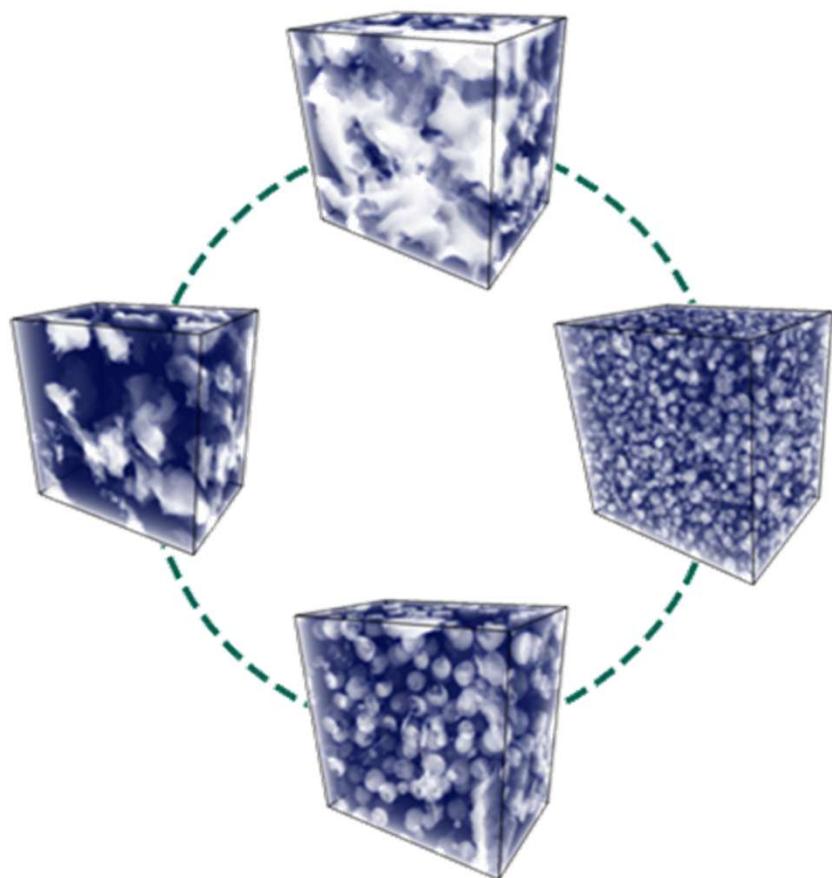
Angew. Chem. Int. Ed. 64 (2025) e202420126.

WO2021259437A1 (2021)



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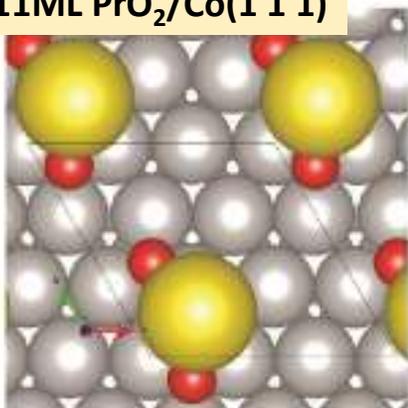
Catalysts with bespoke multimodal porosities



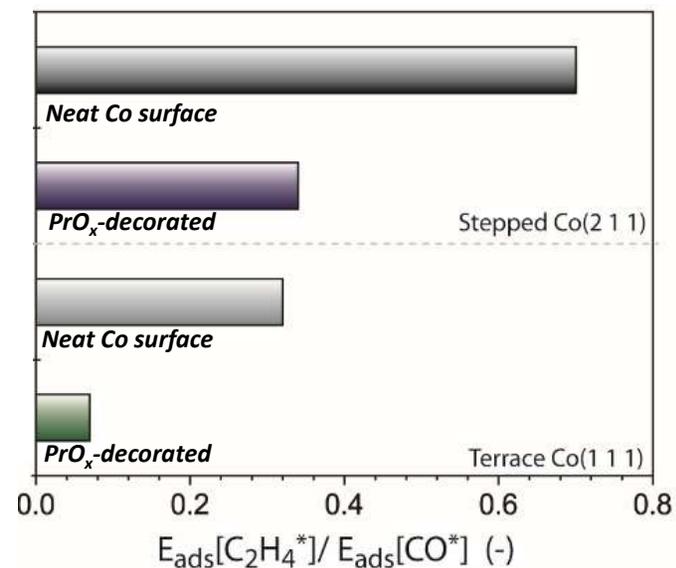
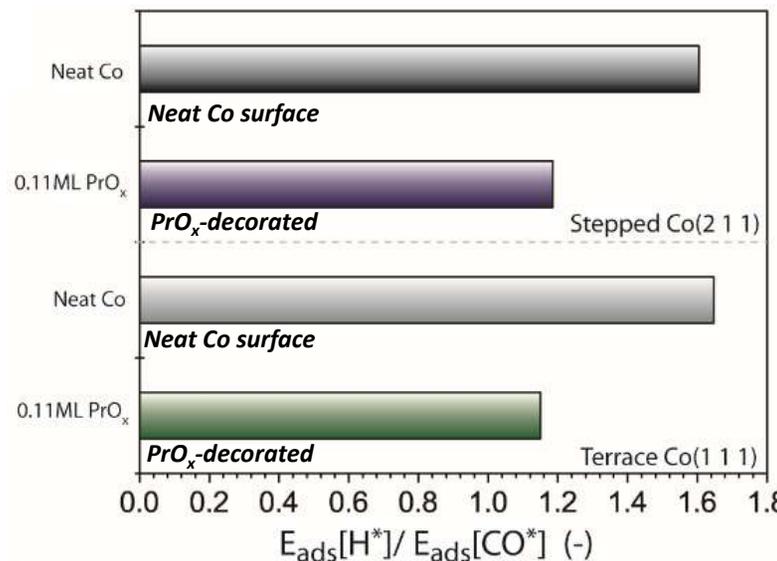
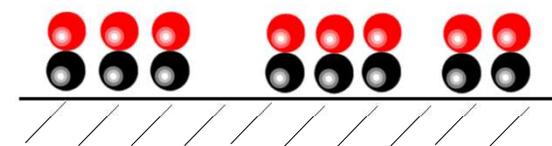
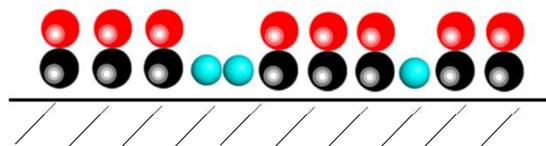
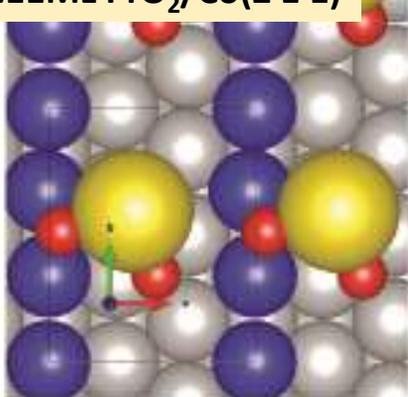
Surface promotion to favor 1-olefin primary products



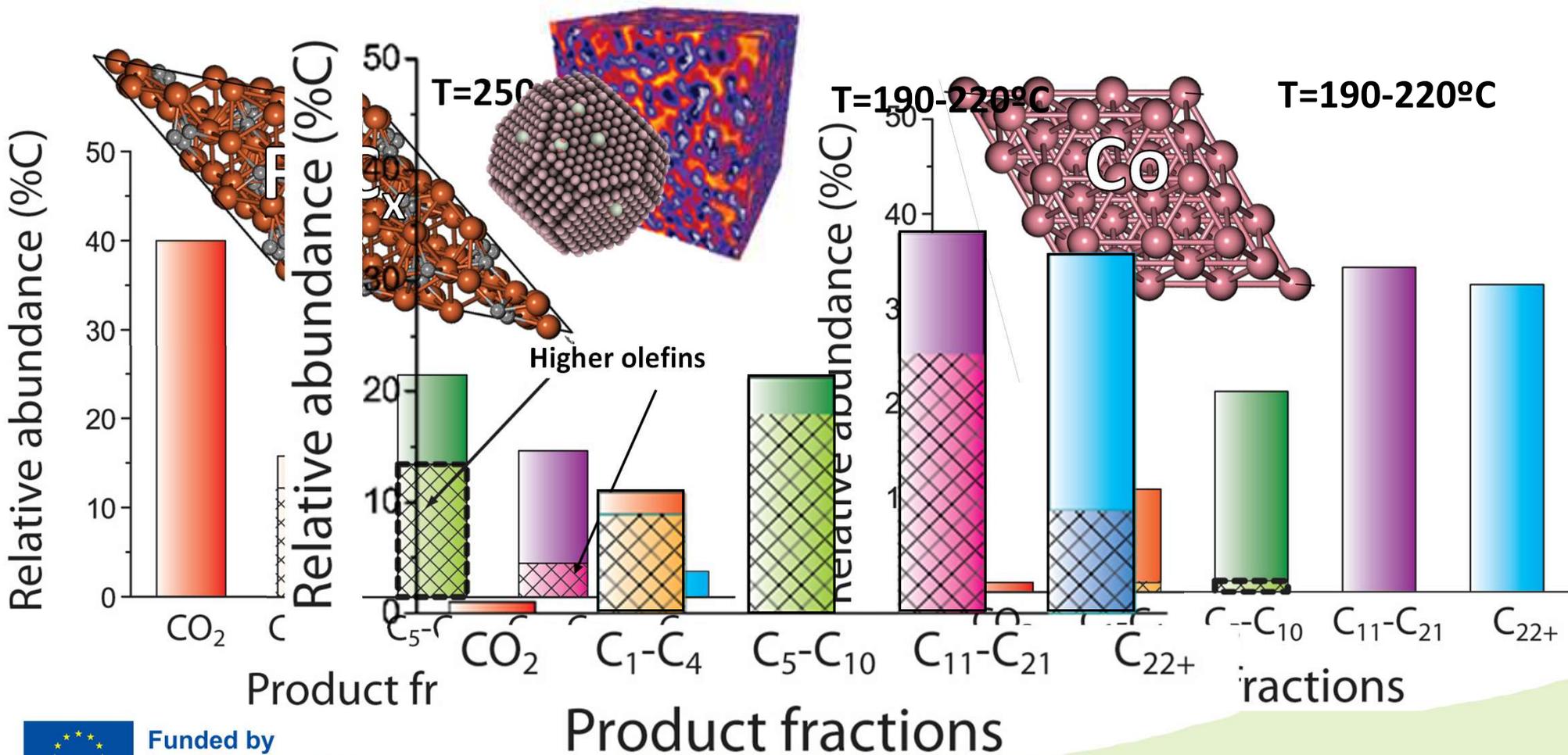
0.11ML PrO₂/Co(1 1 1)



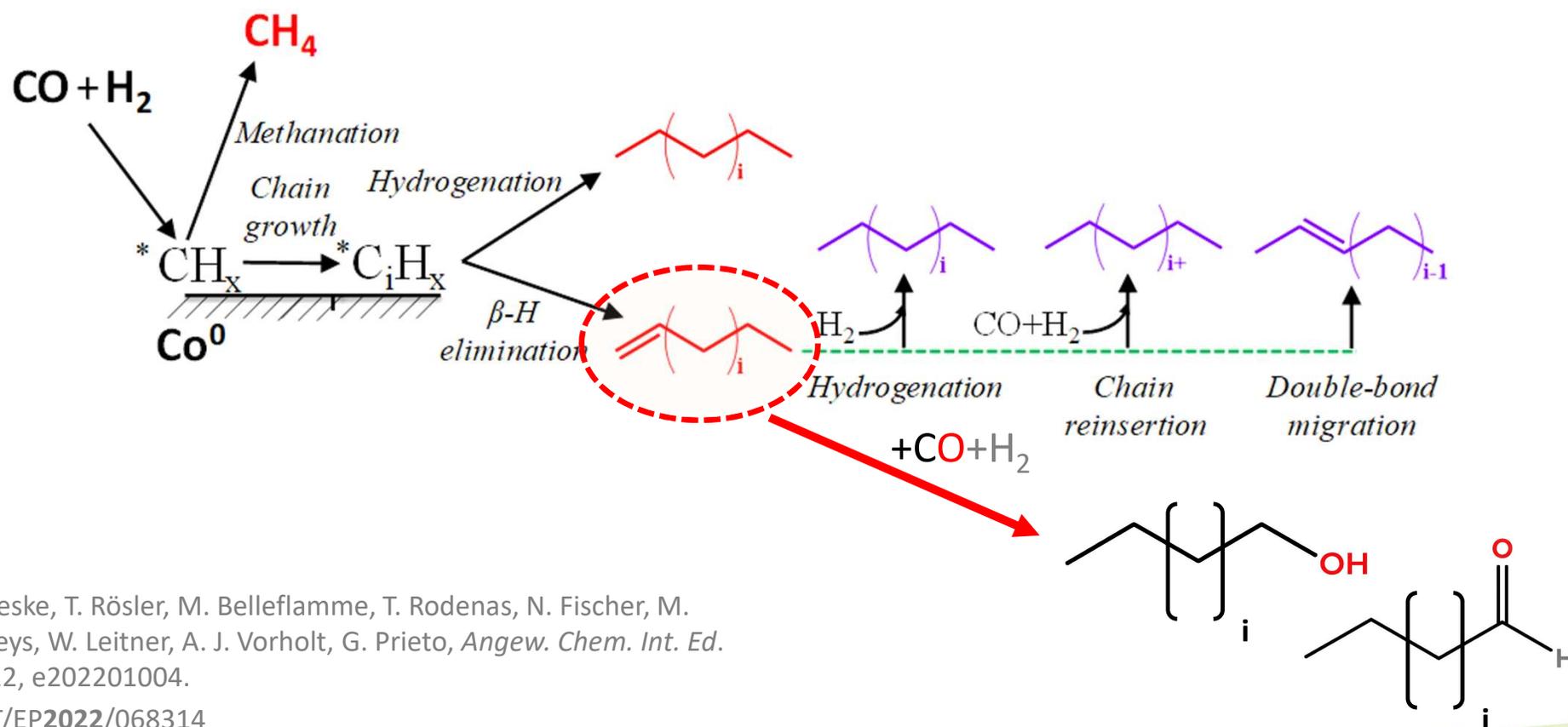
0.11ML PrO₂/Co(2 1 1)



A new higher 1-olefin selective FT catalyst class



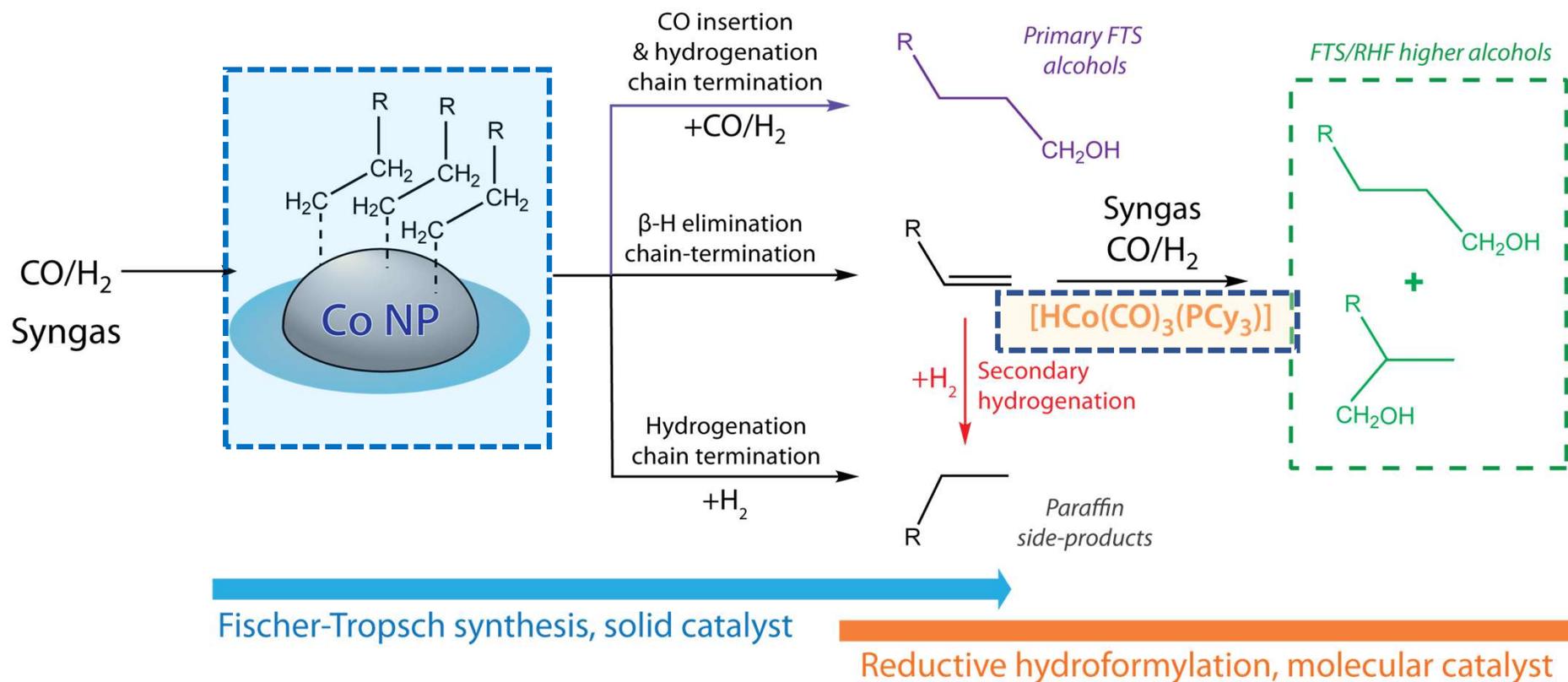
Higher 1-olefin selective FT catalysts in tandem



K. Jeske, T. Rösler, M. Belleflamme, T. Rodenas, N. Fischer, M. Claeys, W. Leitner, A. J. Vorholt, G. Prieto, *Angew. Chem. Int. Ed.* 2022, e202201004.

PCT/EP2022/068314

Direct syngas-to-higher oxygenates by tandem catalysis

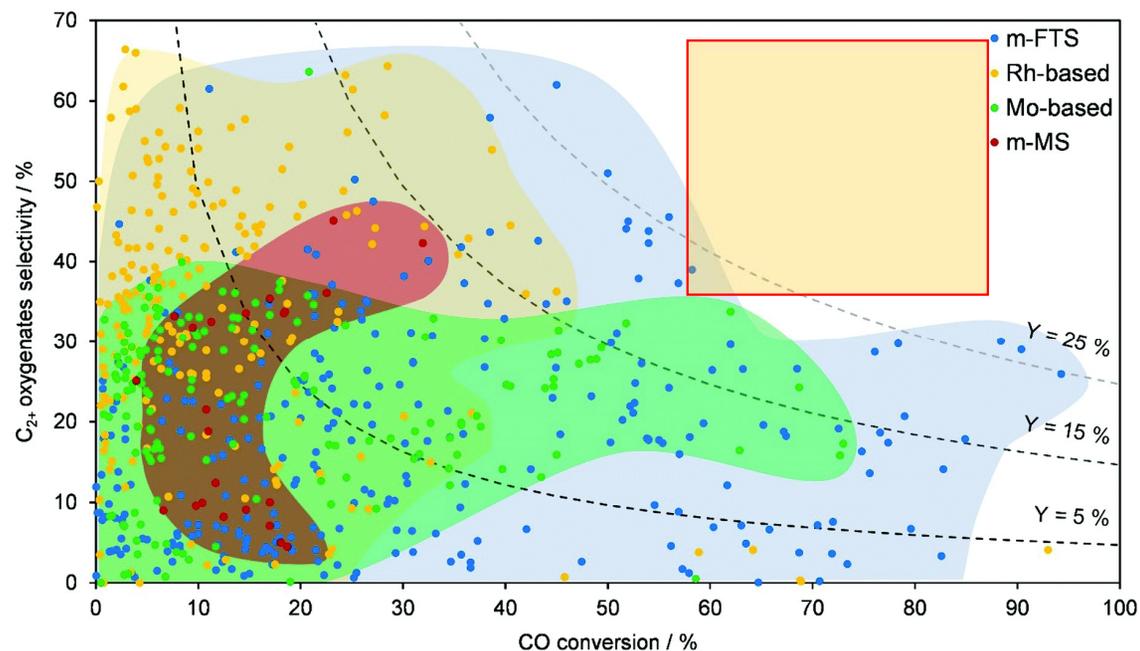
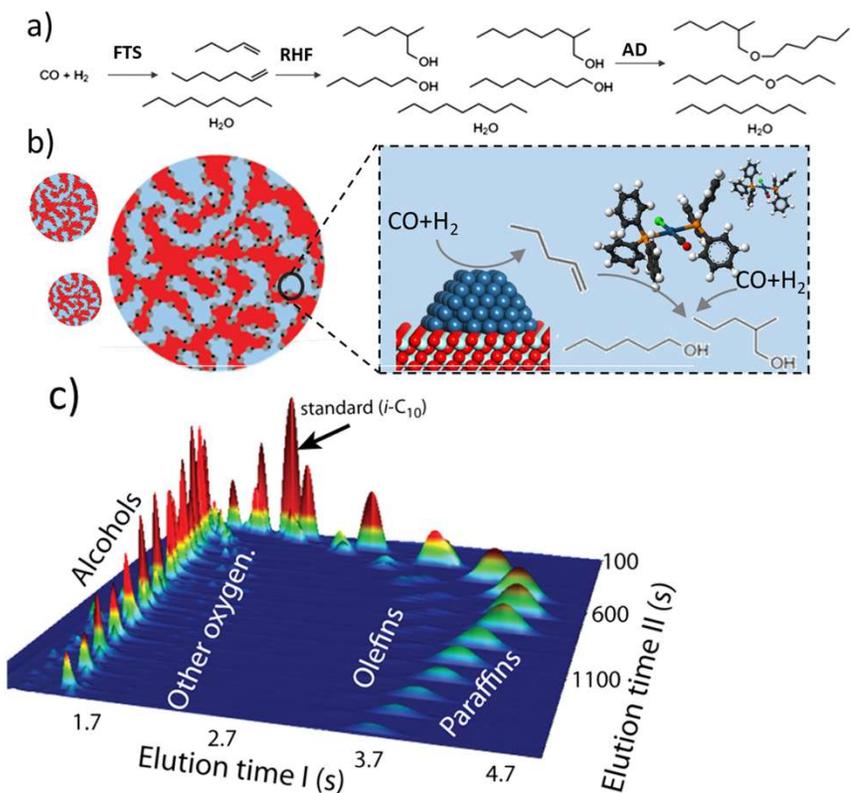


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K. Jeske, T. Rösler, M. Belleflamme, T. Rodenas, N. Fischer, M. Claeys, W. Leitner, A. J. Vorholt, G. Prieto, *Angew. Chem. Int. Ed.* 2022, e202201004.

15/02/2026

Direct syngas-to-higher oxygenates by tandem catalysis



K. Jeske, T. Rösler, M. Belleflamme, T. Rodenas, N. Fischer, M. Claeys, W. Leitner, A. J. Vorholt, G. Prieto, *Angew. Chem. Int. Ed.* **2022**, 61, e202201004; *Angew. Chem.* **2022**, 134, e202201004.
Patent applic. PCT/EP2022/068314

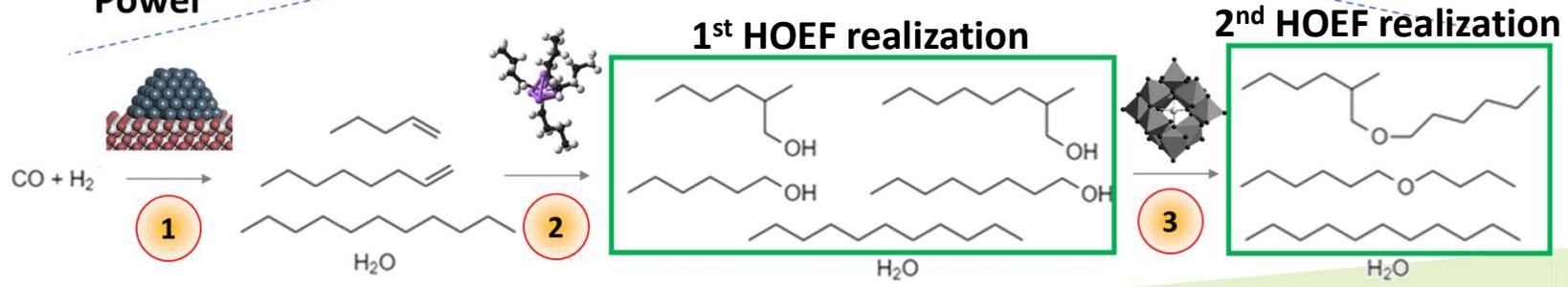
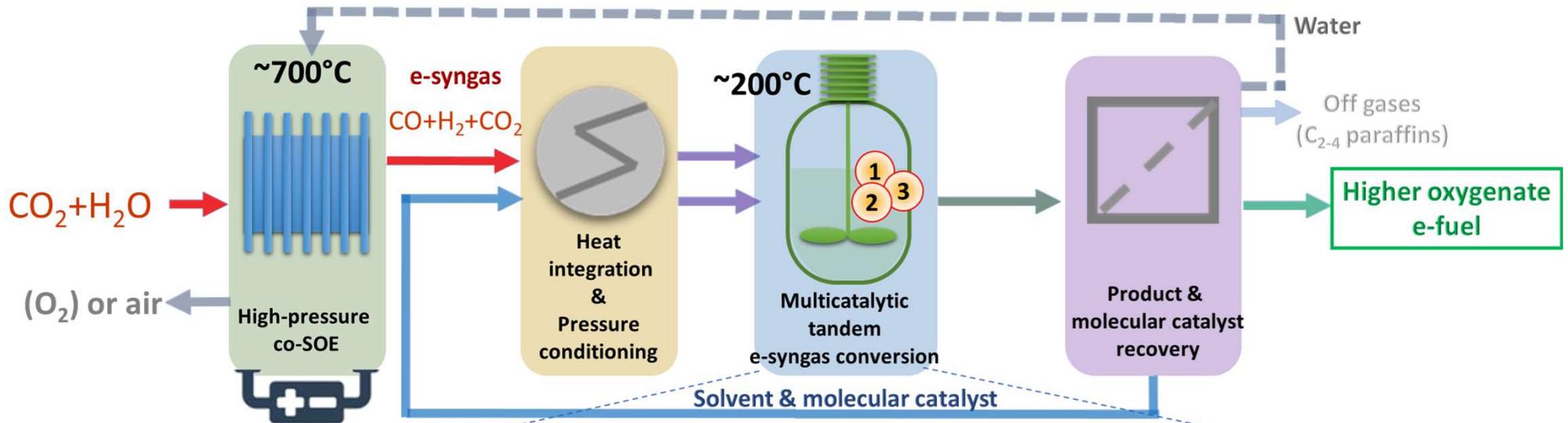
Ho Ting Luk, Cecilia Mondelli, Daniel Curulla Ferré, Joseph A. Stewart and Javier Pérez-Ramírez, *Chem. Soc. Rev.*, **2017**, 46, 1358-1426



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The E-TANDEM e-fuel production concept



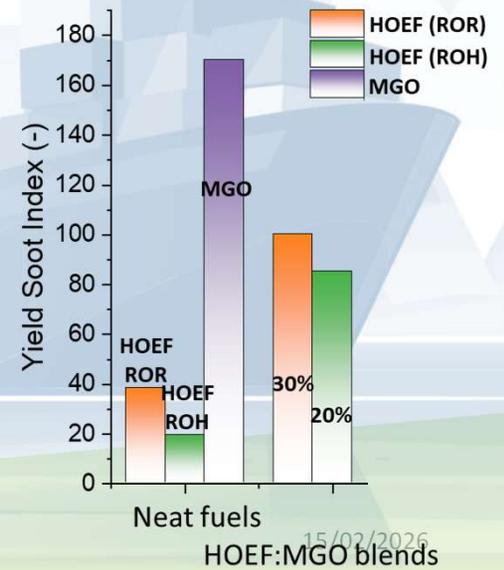
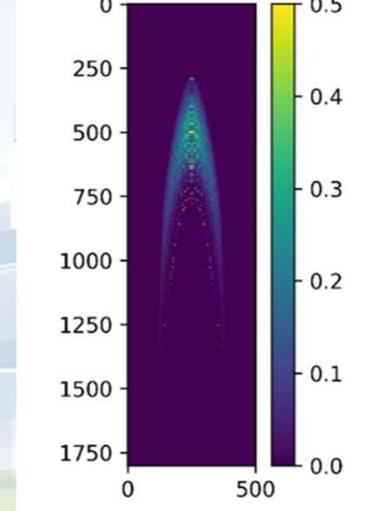
E-TANDEM HOEF: a drop-in e-fuel



Property	Unit	HOEF ethers neat	50%HOEF:50% MGO blend	ISO 8217 DMA MGO
Kinematic viscosity @ 40 °C	mm ² /s	1.5	2.3	≥ 2; ≤ 6
Density @ 15 °C	kg/m ³	796	825	≤ 890
Acid number	mg KOH/g	0.24	-	≤ 0.5
Corrosive effect on copper (3h @ 50 °C)	Corrosion grade class	-	-	-
Oxidation stability	g/m ³	-	7	≤ 25
Flash point	min	10.8	-	-
Cloud point	°C	53	62	≥ 60
CFPP (Cold Filter Plugging Point)	°C	-	-	≤ -16
Pour point	°C	-	-	≤ -6
Water content	mg/kg	211	-	≤ 200 **
Appearance	Rating	1	1	1
		Light yellow	Light brown	Clear & bright
Cetane number	-	113	73	-
Cetane index	-	-	-	≥ 40
Total contamination	mg/kg	-	-	-
Distillation				
(v/v) collected @ 250 °C	%	-	-	-
(v/v) collected @ 350 °C	%	-	-	-
95% (v/v) collected @	°C	-	-	-
Lubricity	µm	-	-	≤ 520
Net heat of Combustion	MJ/kg	38.7	-	-
	MJ/l	30.5 (ca. 16 for MeOH)	-	-



Soot volume fraction [ppm]



15/07/2026

E-TANDEM HOEF: a drop-in e-fuel



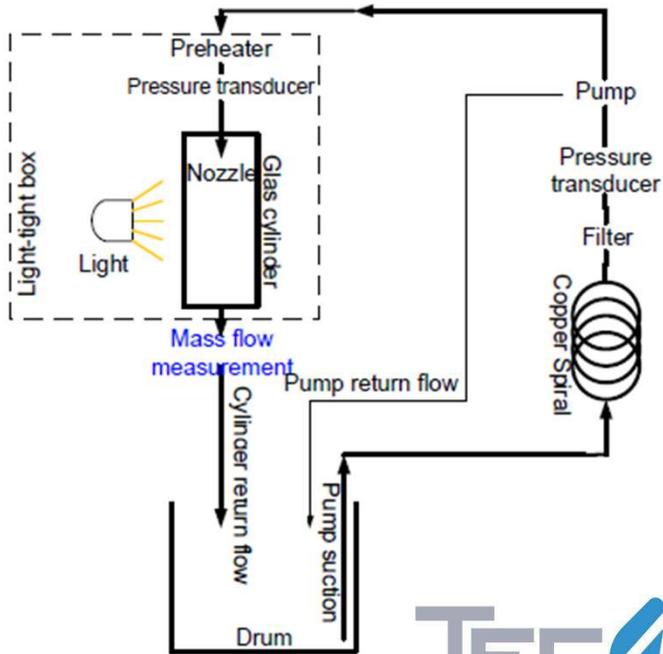
W-FA-55SiCr-QT-SP	HS6-5-2	FVMQ	FKM	PTFE
42CrMo4	18CrNiMo7-6			
	42CrMo4		18CrNiMo7-6	
	(20% blend, 24 weeks)		(20% blend, 24 weeks)	
W-FA-55SiCr-QT-SP				
(10% blend, 24 weeks)				



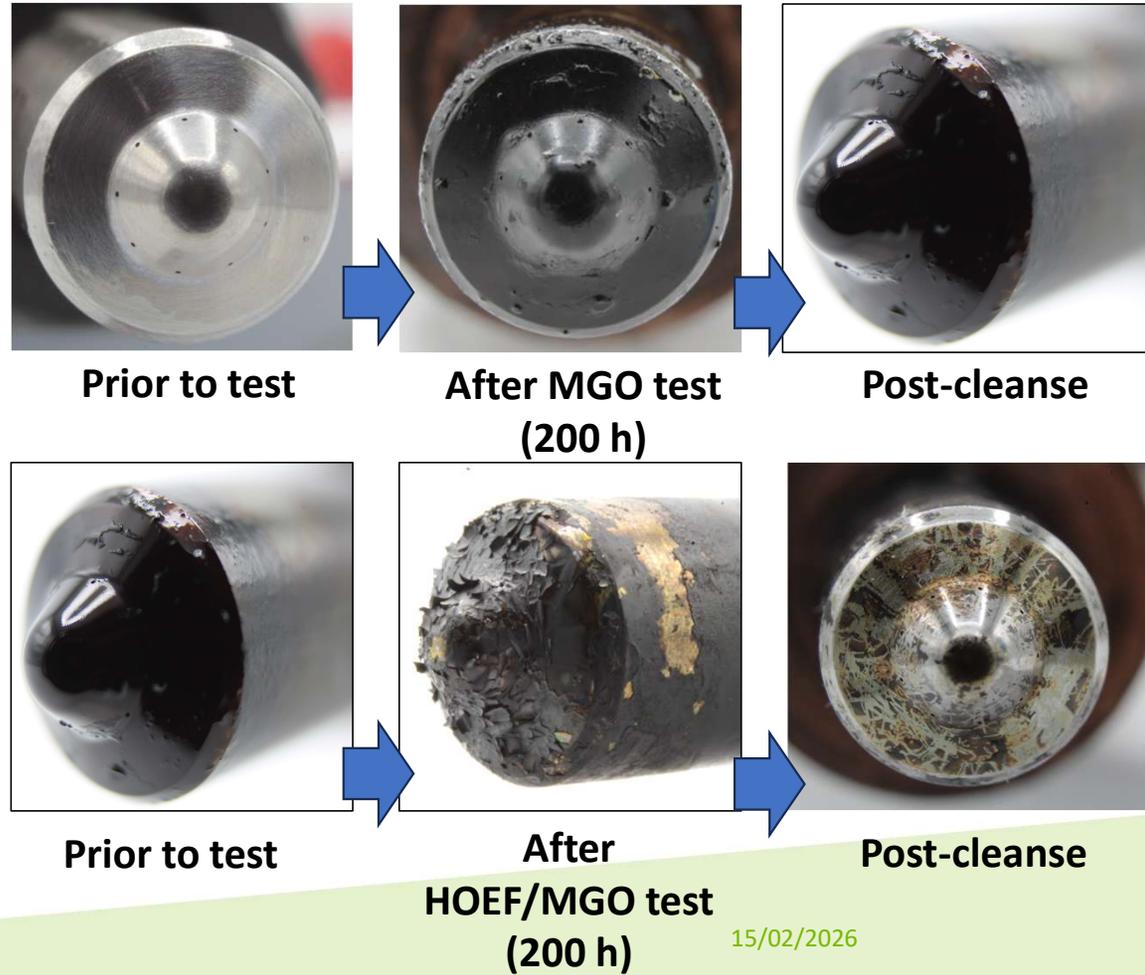
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E-TANDEM HOEF: a drop-in e-fuel



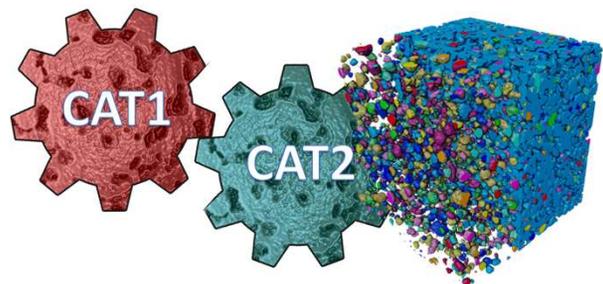
**TEC4
FUELS**



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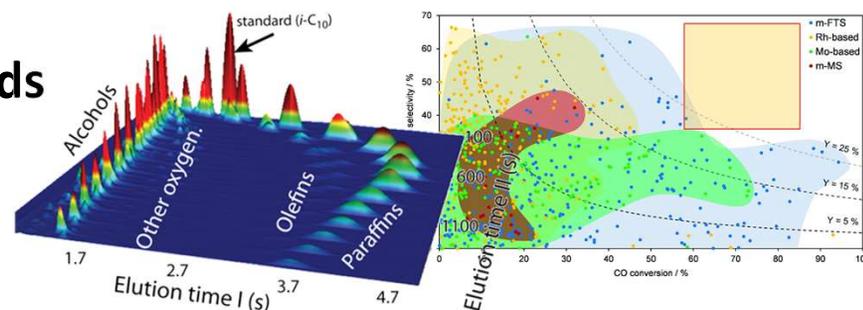
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Wrap-up

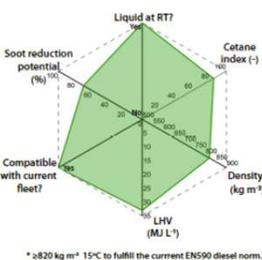


Tandem catalysis to go around intrinsic limitations of syngas conversion: chain-growth vs oxo-functionalization

Direct, selective synthesis of higher oxo-compounds from e-syngas in E-TANDEM



New class of condense e-fuel compounds with interesting drop-in and emission abatement profile



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Funded by the European Union under grant number 101083700. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them.

