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Plant Oils into Everyday Products

Olefin Metathesis

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Green Chemistry for a Sustainable Future

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The Problem with Traditional Catalysts

- Many industries rely on olefins for creating products like biofuels, biodegradable plastics, and perfumes.
- Existing catalysts lose their precision in the presence of moisture, oxygen and at high temperatures required for industrial processes, forcing manufacturers to use energy-intensive, solvent-heavy methods.

The Silicon Valley-Ready Solution

- Researchers developed a new families of "**molecular LEGO master**" catalysts that maintains precision with techical grade substrates, even at 150°C, and in highly concentrated mixtures.
- Key innovations: a CAAC-based complexes with enhanced stability in the presence of ethylene, specially designed ligands that prevents catalyst breakdown under harsh conditions.
- Enables **solvent-free production** of Z-alkenes, cutting costs and waste for industries like biofuels and sustainable materials.

Why This Matters in Silicon Valley

- **Biofuel Revolution**: Converts plant oils into high-value chemicals like 9-DAME (for biodegradable plastics) and 1-decene (for eco-friendly lubricants).
- **Energy Efficiency**: Works at 0.5 ppm concentrations – imagine one sugar cube in an Olympic pool – reducing resource use.
- **Stability**: Tolerates oxygen and impurities, making it practical for real-world industrial use.

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Precision Scents for the Modern World

The Fragrance Industry's Hidden Challenge

- Macrocyclic musk compounds (key to luxury perfumes) require Z-shaped double bonds for their creamy, long-lasting scents.
- Traditional methods use **200x** more solvent than necessary and often produce unwanted isomers (E-alkenes smell harsh or rancid).

Silicon Valley-Scale Innovation

- The Ru3 catalyst enables **high-concentration reactions** (200-700 mM vs. traditional 1-10 mM), slashing solvent use by 99%.
- Reactive distillation continuously removes products, avoiding costly purification steps.
- Results: **93% Z-selectivity** for compounds like Yuzu lactone (used in citrus perfumes) and musk macrocycles at industrial scales.

Silicon Valley Opportunities

- **Sustainable Perfumery**: Partner with cosmetic giants to create biodegradable, plant-based fragrances.
- **AgTech**: Synthesize insect sex pheromones for eco-friendly pest control in vertical farms.
- **Carbon Neutrality**: Replace petrochemicals with bio-sourced oils in materials science startups.

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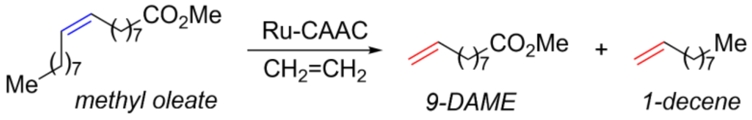
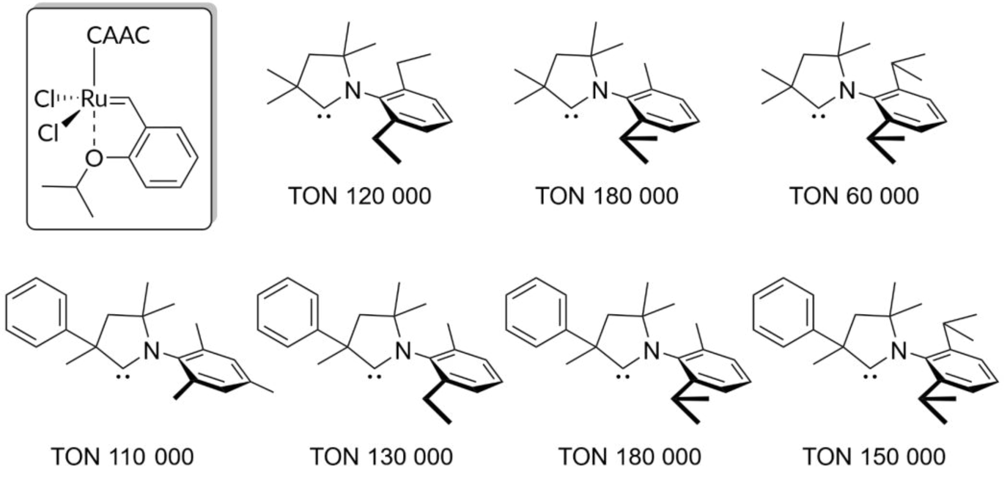
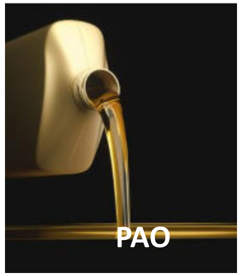
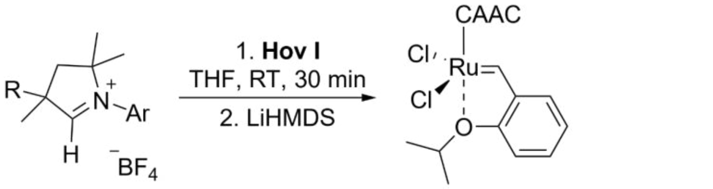
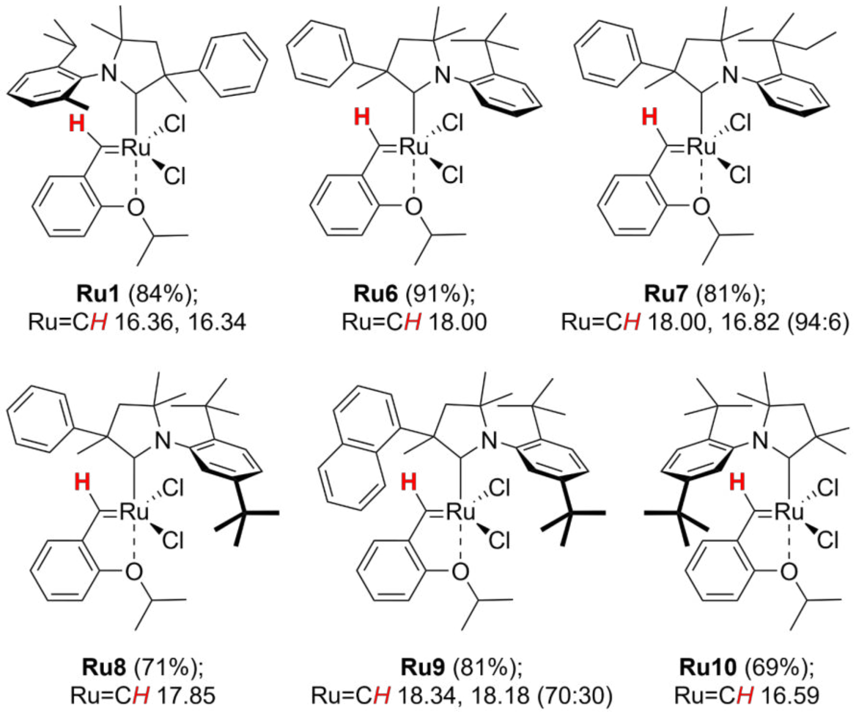
Ethenolysis

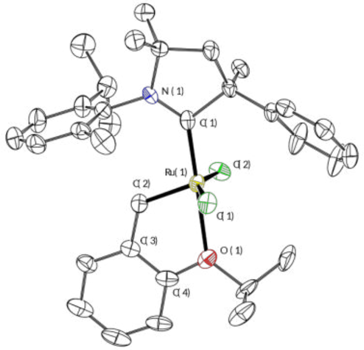




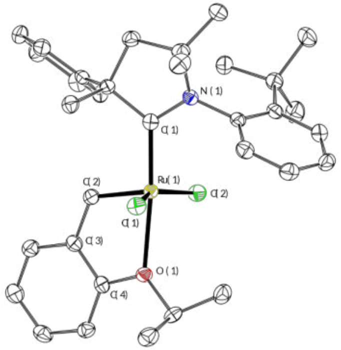






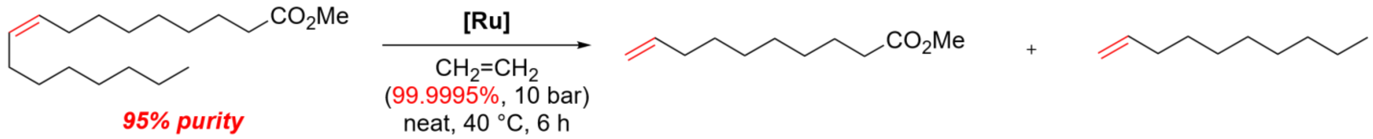


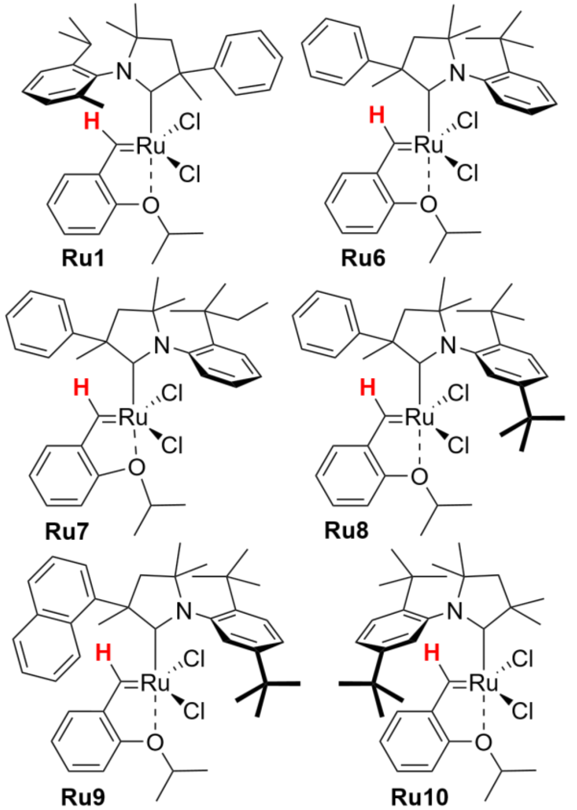
Ru1



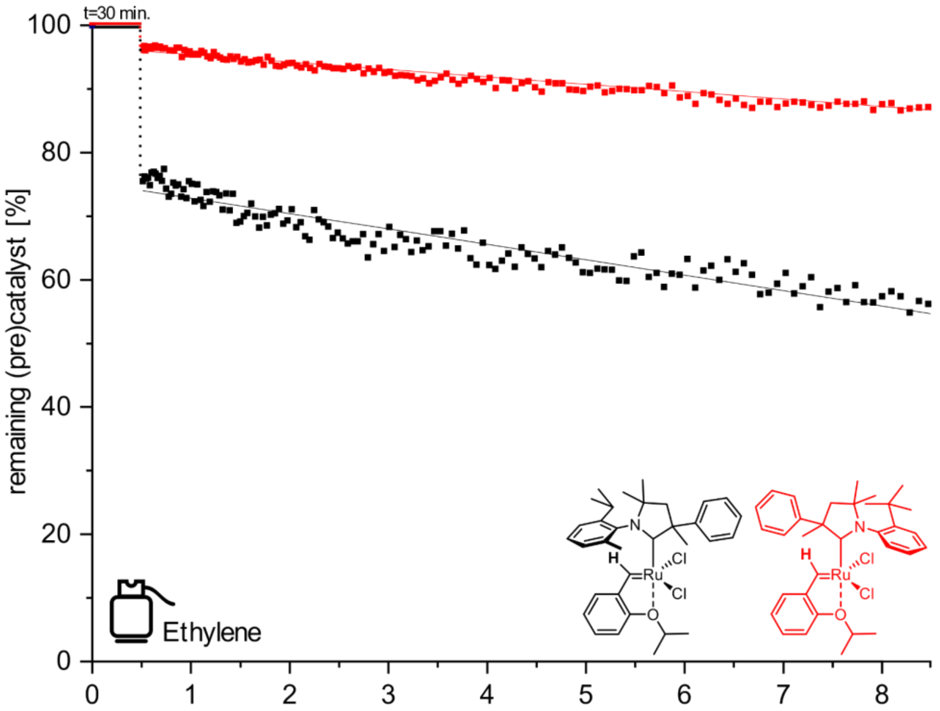
Ru6

Ethenolysis



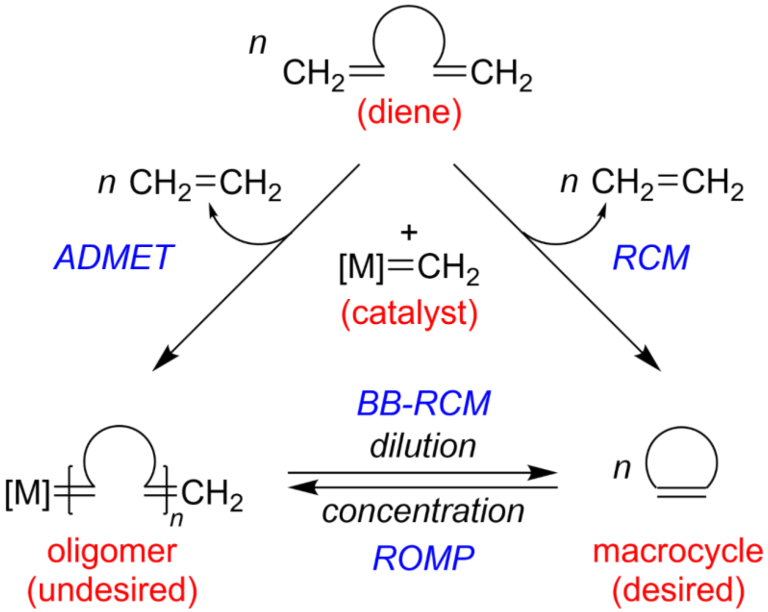


[Ru]	Loading [ppm]	Conversion [%]	Selectivity [%]	TON
Ru1	3	54	96	173 000
	½	19	97	360 000
Ru6	3	83	88	244 000
	½	40	93	744 000
Ru7	3	81	89	242 000
	½	29	93	536 000
Ru8	3	80	90	240 000
	½	23	90	409 000
Ru9	3	80	89	237 000
	½	38	95	723 000
Ru10	3	56	35	65 000
	½	13	8	20 000

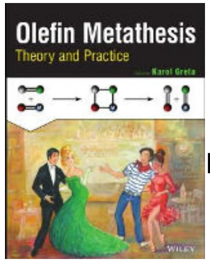


Sytniczuk, A.; Kajetanowicz, A.; Grela, K.; *Chem Catal.* **2023**, *3*, 100713.
Pat. Appl. PL441535A1**, Pat. Appl.** PCT/IB2023/056530

Macrocyclisation at high concentration



General Entropic Factors that Influence the Concentration-Dependence of RCM Yields



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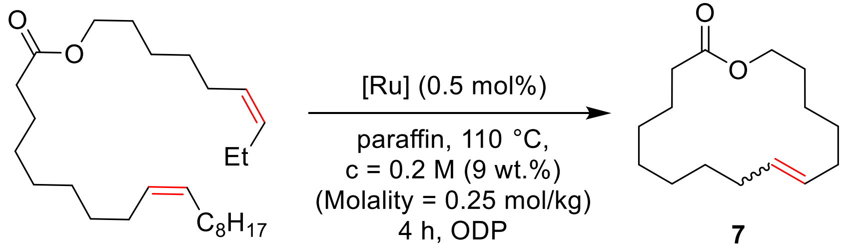
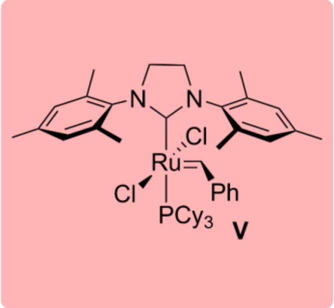
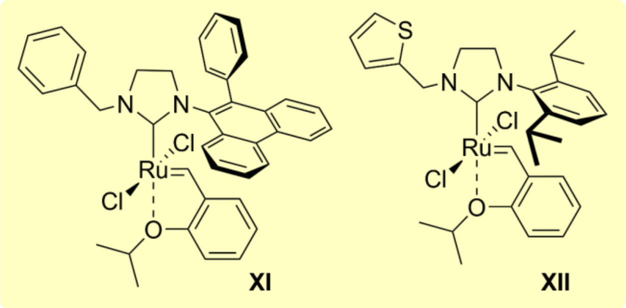
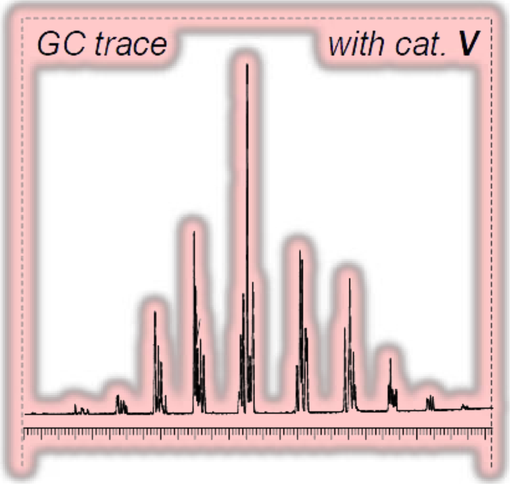


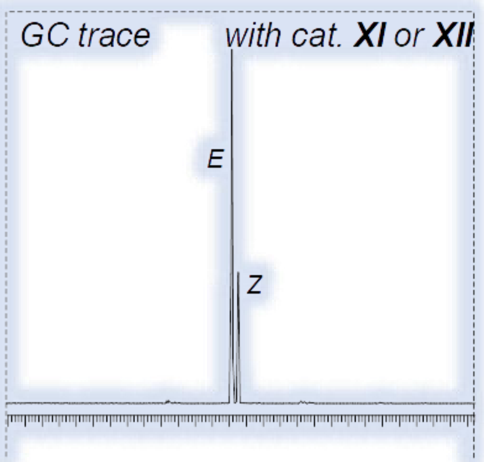
6 **7**

Entry	Catalyst	Yield (%)	Sel. (%)	(*E*):(*Z*)
1	**II**	9	26	n.d.
2	**III**	17	47	n.d.
3	**V**	46	13	n.d.
4	**VI**	16	18	n.d.
5	**VII**	51	23	n.d.
6	**VIII**	23	80	3.5
7	**IX**	52	63	3.2
8	**X**	89	70	2.8
9	**XI**	95	98	3.0
10	**XII**	97	94	3.2
11	**XIII@MOF**	82	96	3.5

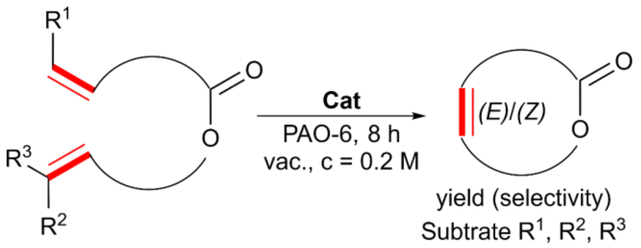


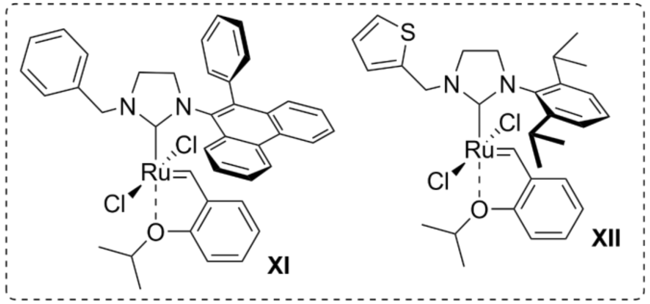


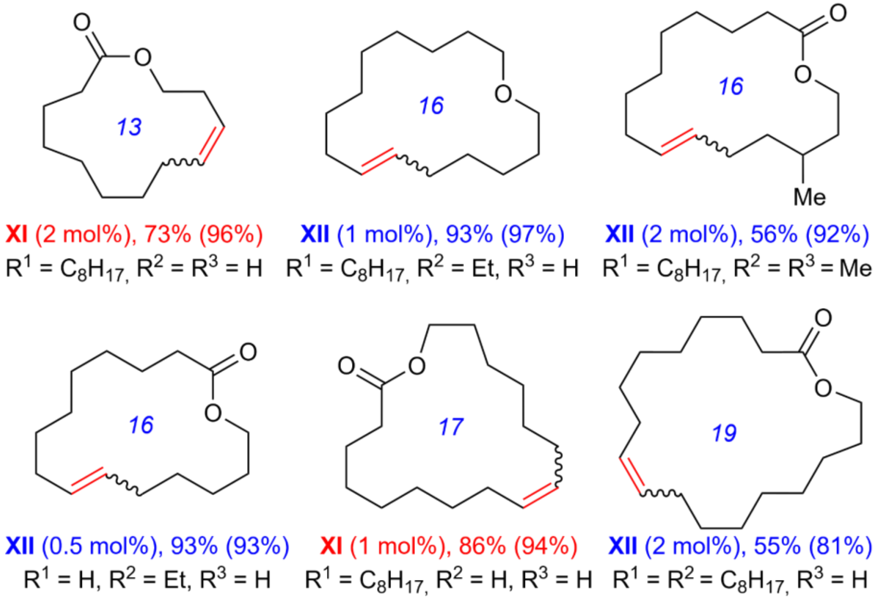




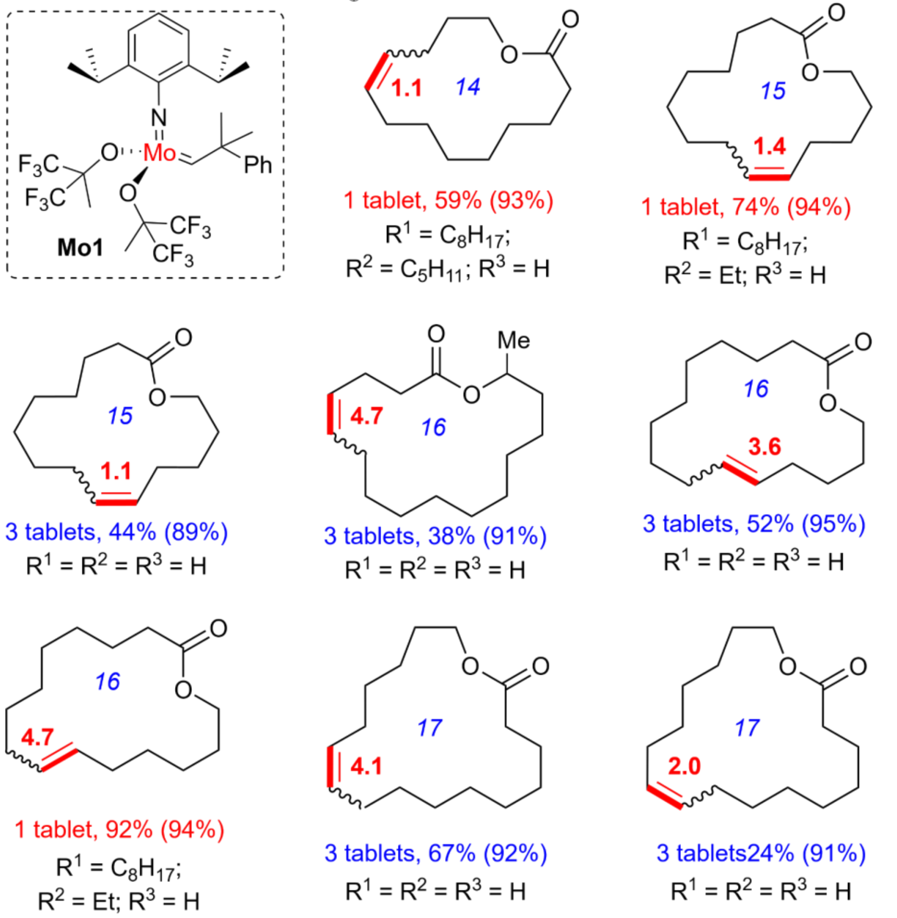
Macrocyclisation at high concentration





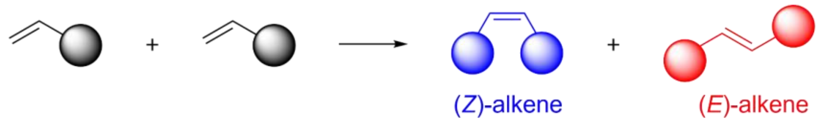


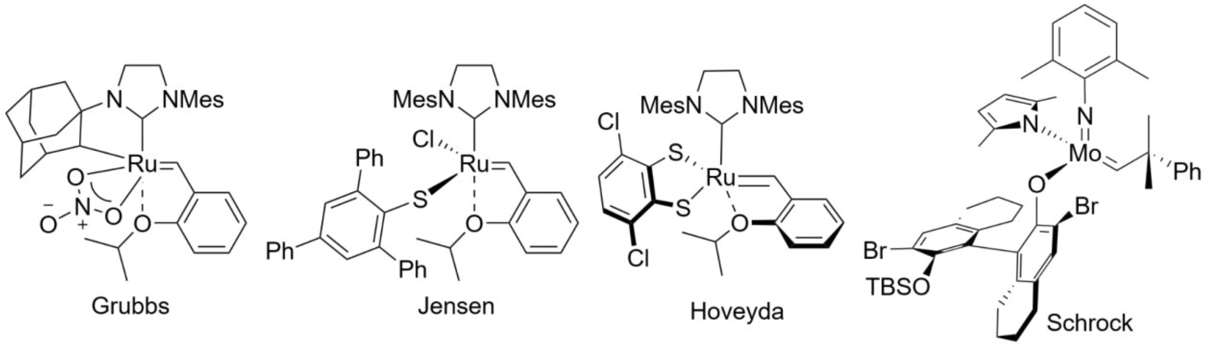
Sytniczuk, A.; Dąbrowski, M.; Kajetanowicz, A.; Grela, K., et al. *J. Am. Chem. Soc.*; **2018**, *140*, 8895-8901.



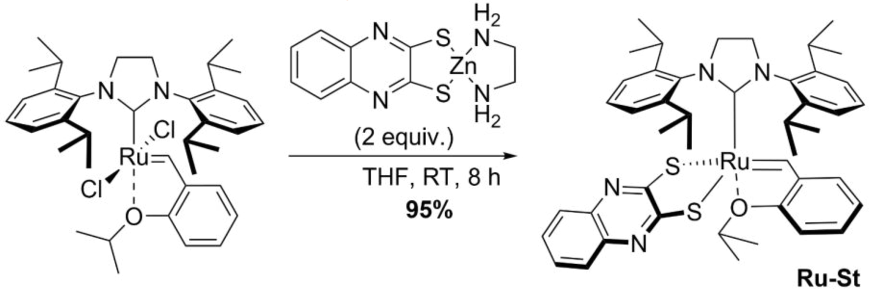
Sytniczuk, A.; Milewski, M.; Dąbrowski, M.; Grela, K.; Kajetanowicz, A., *Green Chem.* **2023**, *25*, 2299-2304.

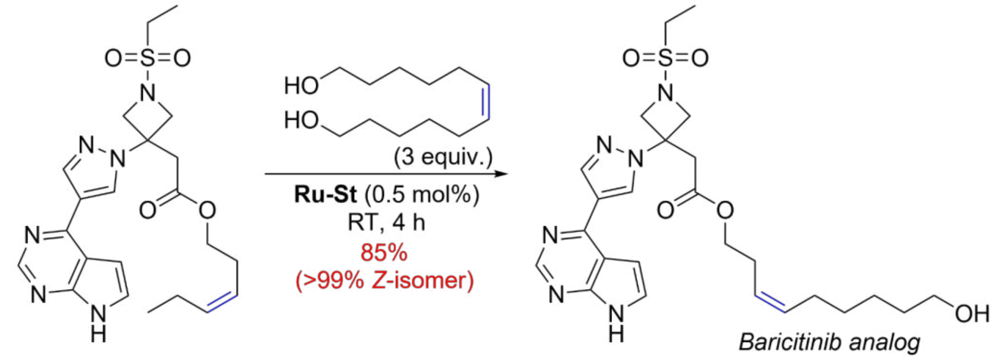
Stereoretentive catalysts

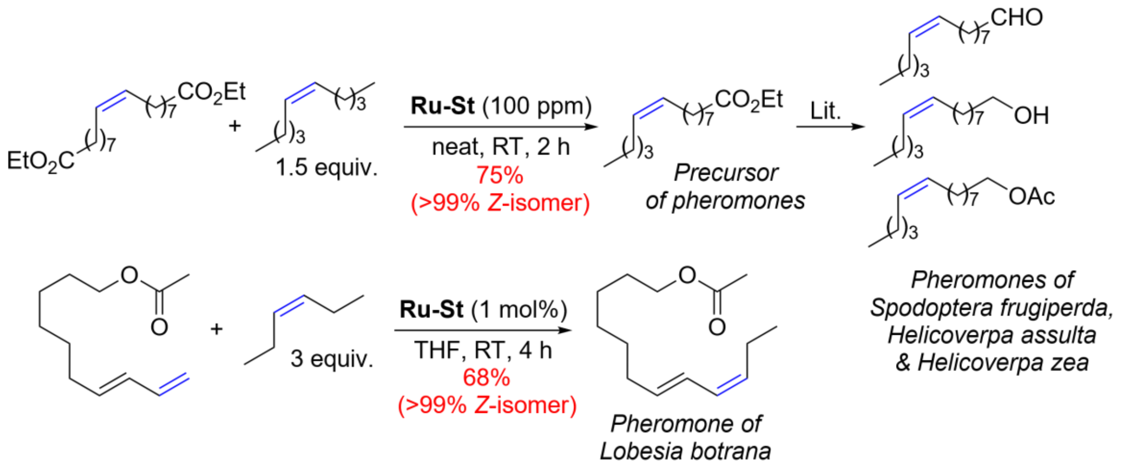




scalable up to 100 gram







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Prof. Anna Kajetanowicz *– deputy head, author of more than 75 scientific papers and 4 patents families*
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