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Pyrolytic Recovery as a Prospective Use of Plastic Waste Materials

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Plastics Production and Utilization

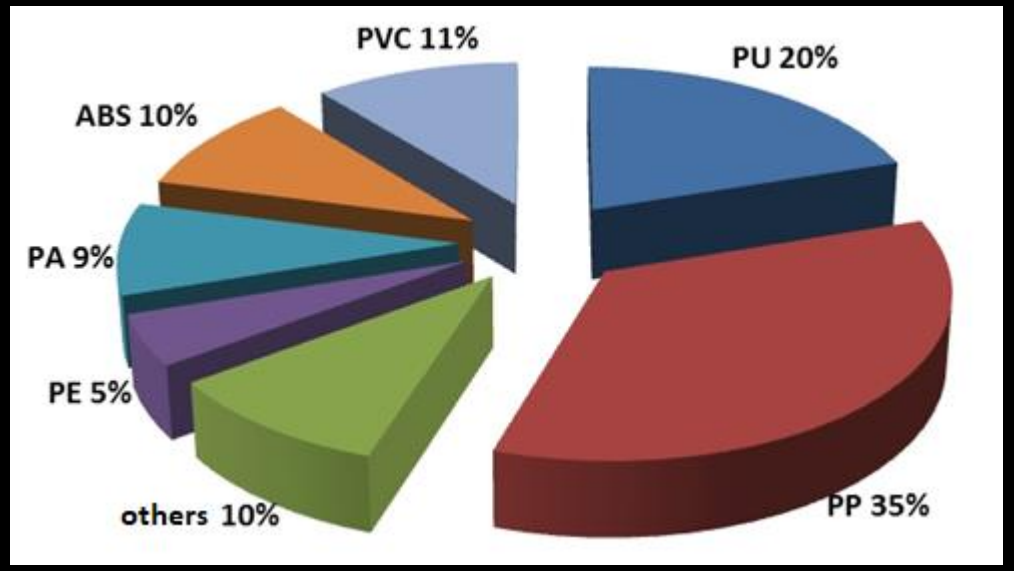


Table 1: The proportion of plastics in cars (Olexová et al. 2008)

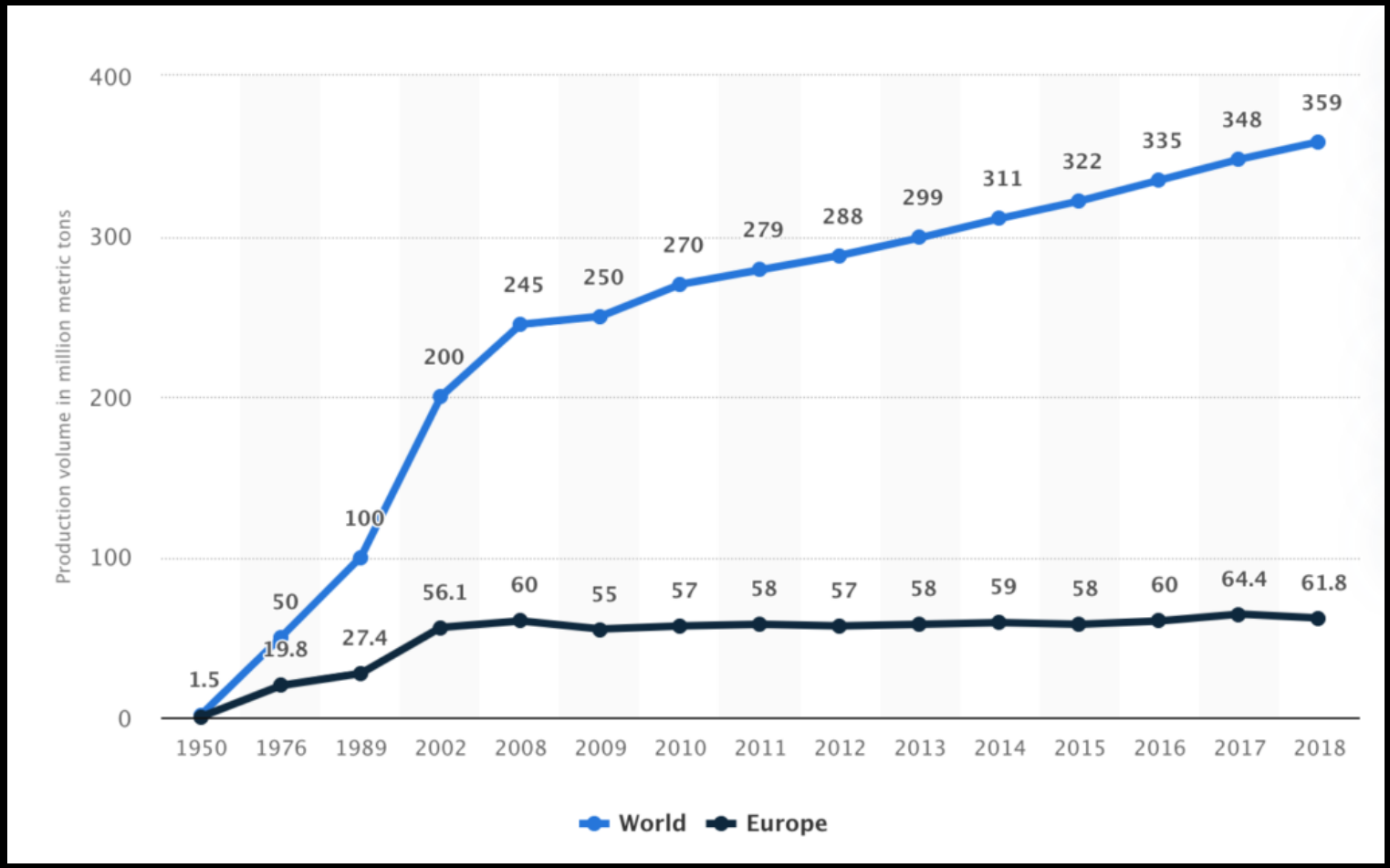
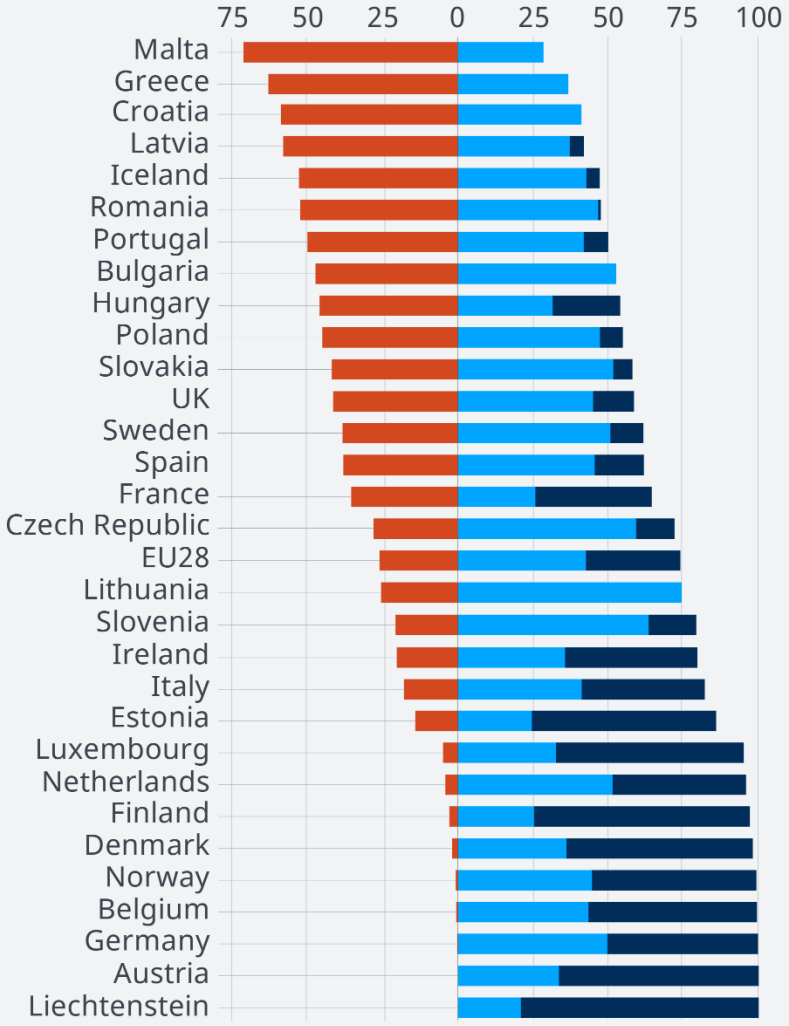


Table 2: Total global production of plastics
(https://www.brinknews.com/quick-take/plastic-production-on-the-rise-worldwide-declining-in-europe/7/)

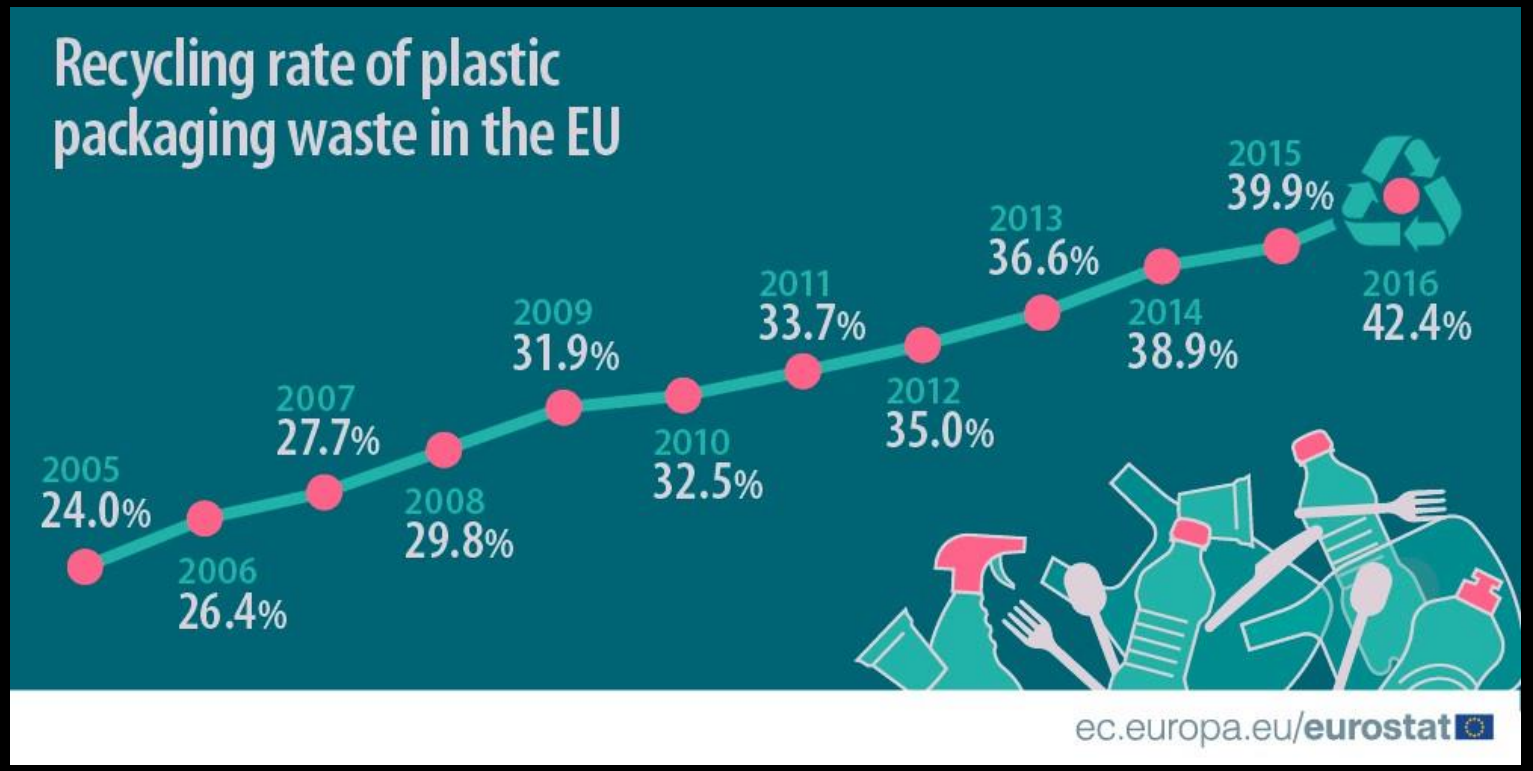
Plastic: Wasted or recovered?

Share of plastic packaging waste that is
- Not recovered (e.g. ends up in landfills)
- Recycled (e.g. materials reused)
- Otherwise recovered (e.g. incinerated for energy)



Source: Eurostat (env_waspac), latest available data for each country (2015 or 2016)

Recycling rate



Material and Methods

Material

PE – disposable gloves
PP – food container
PS – glass

Methods

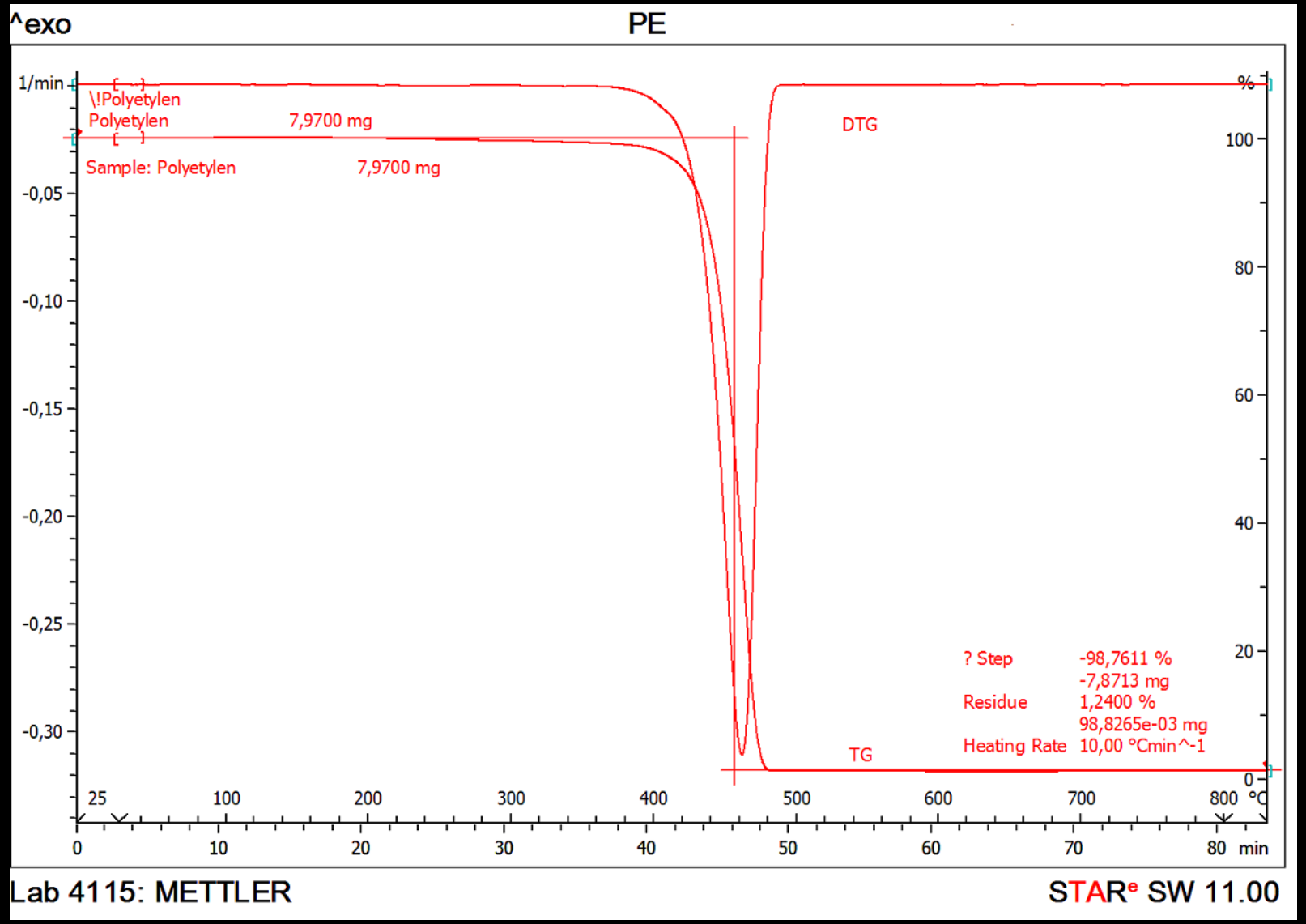
- Low temperature pyrolysis – 60 minutes
- Thermogravimetric analysis (TG)- nitrogen atmosphere, flow rate of 50 ml/min^{-1} , temperature from 30 to 800°C
- Pyrolysis and GC-MS analysis (Py-GC-MS)- CDS Pyroprobe 5150; GC 7890A, MS 5975C (MSD) with ion source (Agilent Technologies)

Results – Low Temperature Pyrolysis

Table 4: Composition of individual phases of samples

sample	phases	content (%)
PE	solid	50
	aqua	30
	gas	20
PP	solid	50
	aqua	34
	gas	16
PS	solid	9.6
	aqua	41
	gas	49.4

Results – TG analysis



Results – Py-GC-MS analysis

PE- Totally 26 products, especially 1-alkenes (most 1-hexane-13.72 %), 2-alkenes, alkanes, various alkyl alkanes and, to a alkyl cyclopentane,...

- Alkadienes in the pyrolysis products were not determined, although they were identified in the PE pyrolysis products by Kusch (2016)

Results – Py-GC-MS analysis

PP- Totally 36 products, especially 1-heptene (propylene trimer)- 38.35%, dimer 2-methyl-1-pentene - 9.19%.

- In contrast to Tsuge et al. (2011) and Kusch (2016), besides alkanes, alkyl alkanes, there was a relatively great amount of alkyl cycloalkanes, even aromatic hydrocarbon styrene (1.36%) present in our pyrolysis products.

- There were no monomers discovered in PE or in PP degradation products.

Results – Py-GC-MS analysis

PS- Totally 20 products, especially styrene 80.25%, toluene, ethylbenzene and alpha-methylstyrene, other alkyl benzene, cycloalkanes, and cycloalkenes

Summary

- PS sample has the largest amount of pyrolysis oil and pyrolysis gases;
- The PP sample seems to be the most stable in the TG analysis with the area of thermal stability up to 320 ˚C.
- Py-GC-MS analysis: 36 chemical compounds was identified in the PP sample (food container), the content of propylene trimer and dimer was the highest one (can be used as a source of fuels and for energetic purposes).
- The highest content of the monomer resulted from the PS pyrolysis (80.25% styrene).
- Pyrolysis products could be used as a source of chemicals or in the process of preparing fuel

REFERENCES :

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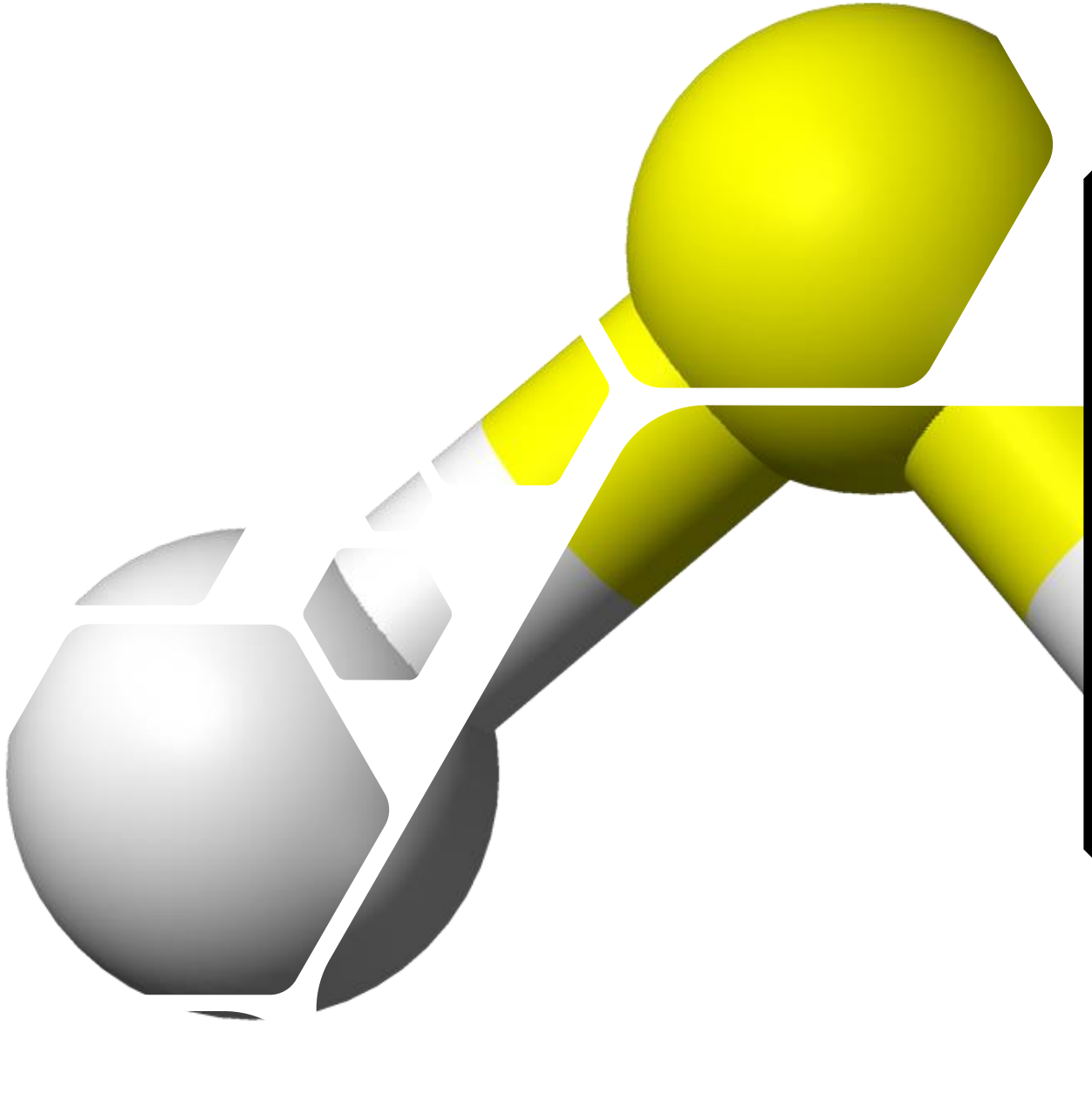
- Tsuge, S. Ohtani, H. Watanabe, C. 2011. Pyrolysis – GC/MS Data Book of Synthetic Polymers, 2011. DOI:10.1016/B978-0-444-53892-5.10005-7



Thank you for your Attention!