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Differential impact of biogenic and anthropogenic secondary organic aerosol (SOA) compounds adsorbed on soot particles in lung cell models at the air-liquid interface (ALI)

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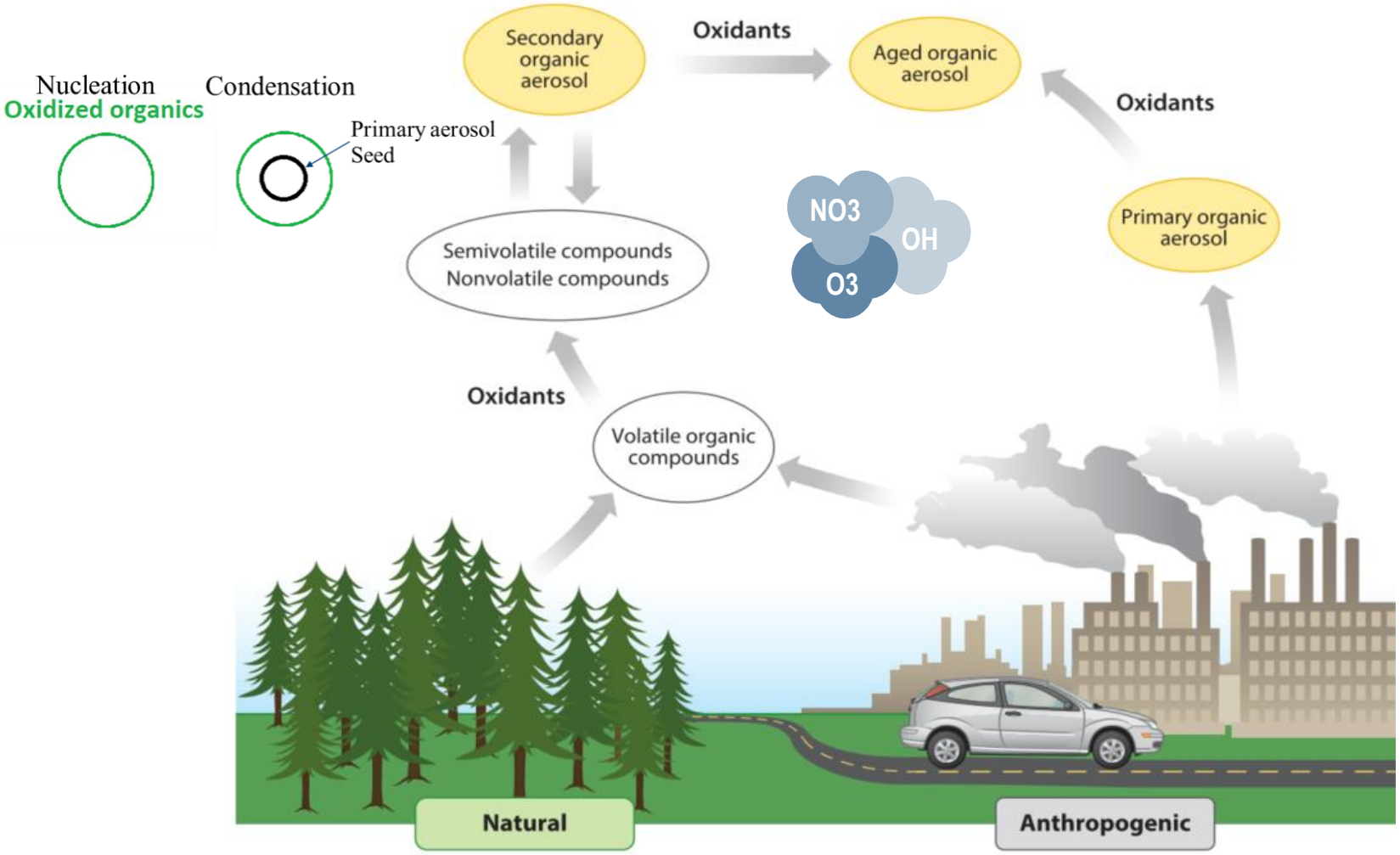
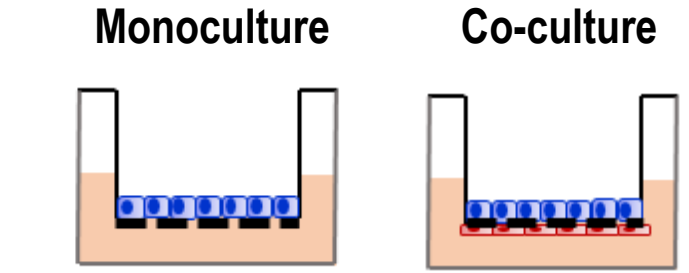
Aerosols and their Health Effects

Health Effects ???

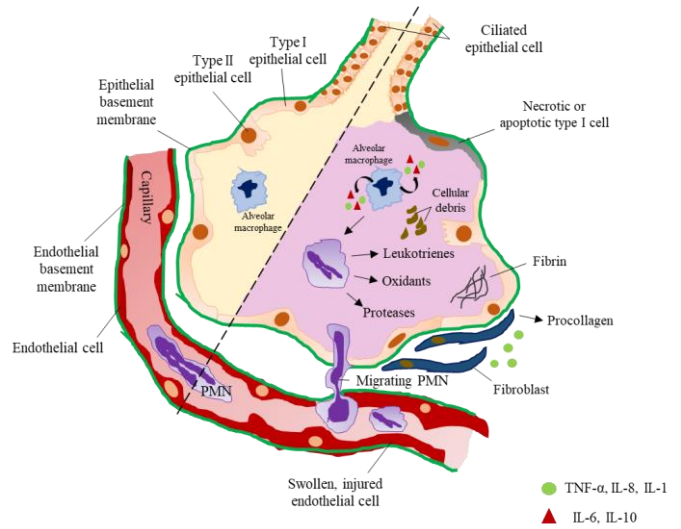


Modified from: Johnston et al. *Annu. Rev. Anal. Chem.* Vol 12: 247-274 (2019).

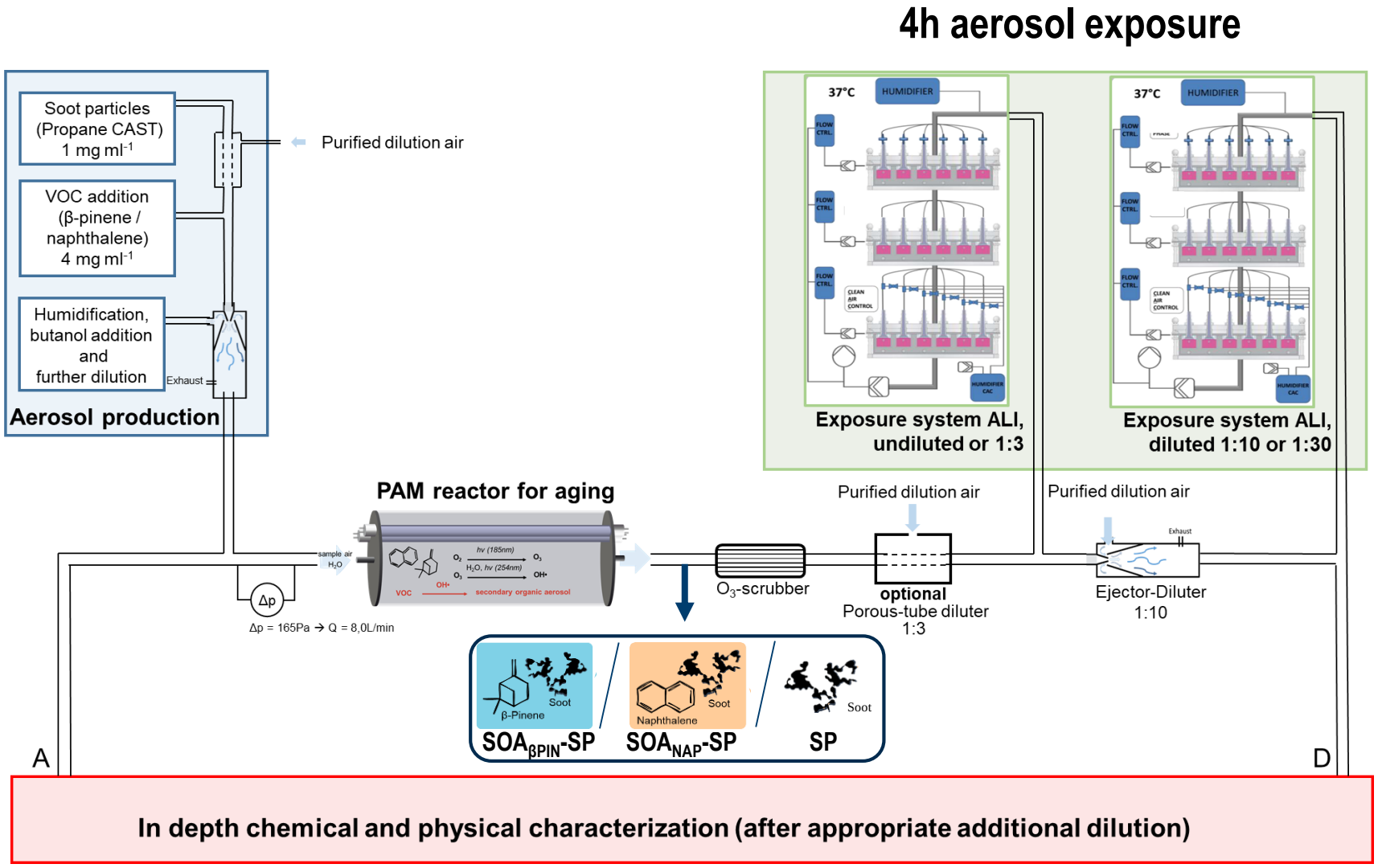


: Adenocarcinoma alveolar type II epithelial cells (A549)

: Endothelial cells (EA.hy 926)



Simulating Aerosol Aging in the Lab



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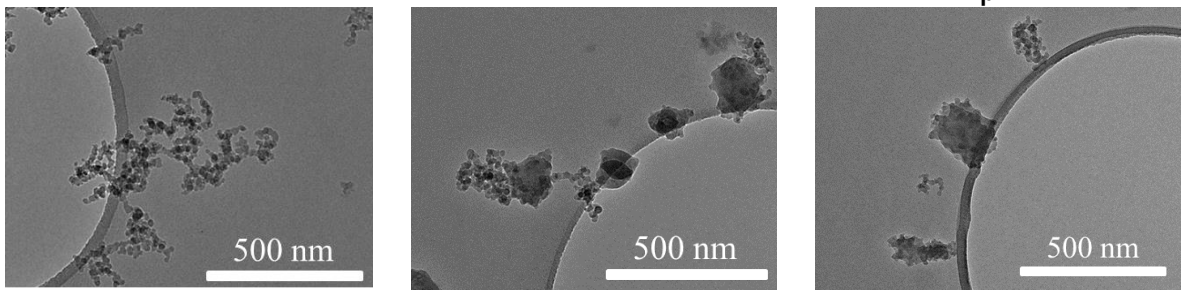
Aerosol characterization



	units	instrument	SP	SOA$_{NAP}$-SP	SOA$_{\beta PIN}$-SP
BC	mg m^{-3}	Aethalometer	1.3 ± 0.1	1.5 ± 0.1	1.4 ± 0.1
Days atmos. OH age	days*	PTR-MS	0	2.9 ± 0.4	2.8 ± 0.2
Particle number conc.	# cm^{-3}	CPC	1.3 x10^6 ± 0.3 x10^6	1.4 x10^6 ± 0.2 x10^6	0.9 x10^6 ± 0.2 x10^6
Particle geo. mean diameter	nm	SMPS	117 ± 1	114 ± 1	117 ± 1
Total EC	mg m^{-3}	Carbon analyzer	0.7 ± 0.1	1.0 ± 0.2	0.7 ± 0.1
Total OC	mg m^{-3}	Carbon analyzer	0.3 ± 0.2	1.1 ± 0.2	1.0 ± 0.2
Deposition	ng cm^{-2}	Calculation	9 ± 1	28 ± 2	17 ± 2

*assuming an average ambient hydroxyl radical concentration of 10^6 molec m^{-3}

similar particle shapes of soot agglomerates coated with organic material

soot particles (SP) retain their fractal structures

stable aerosol aging for all sources

similar aerosol characteristics for SOA

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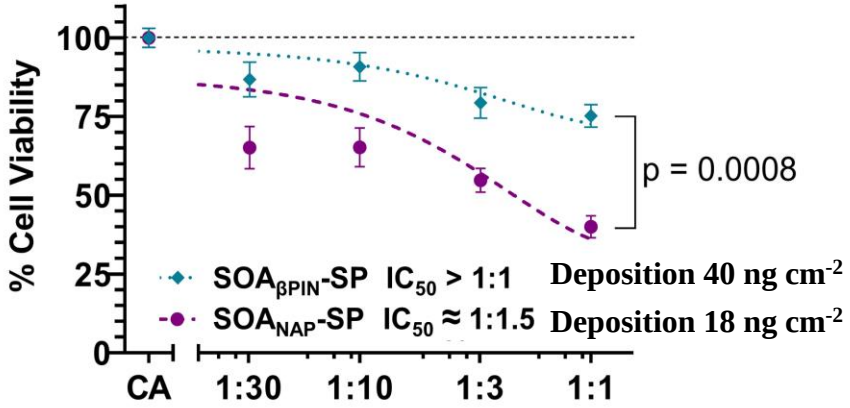
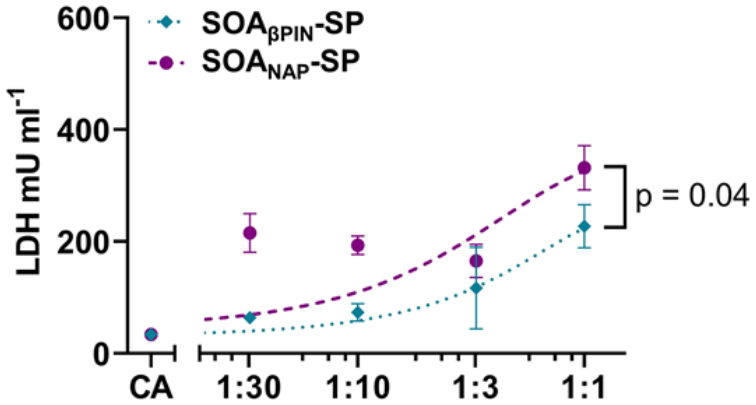
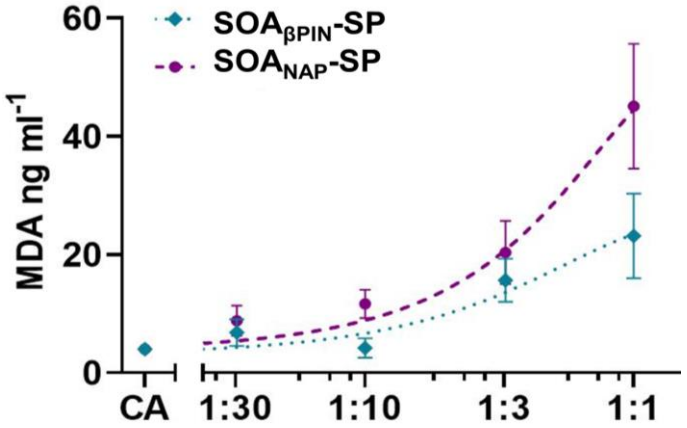
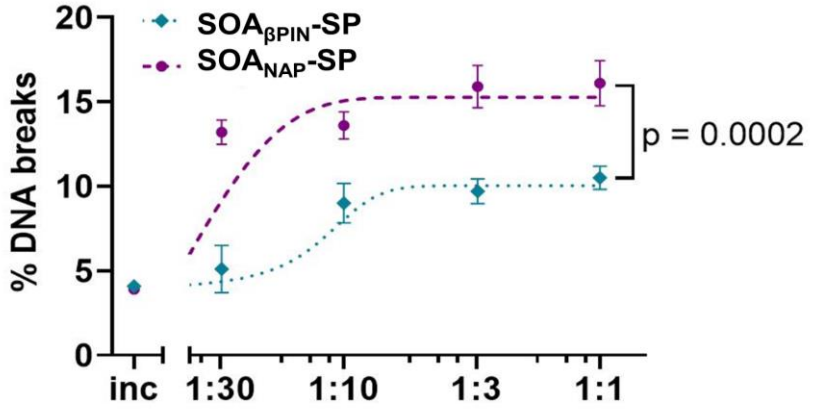
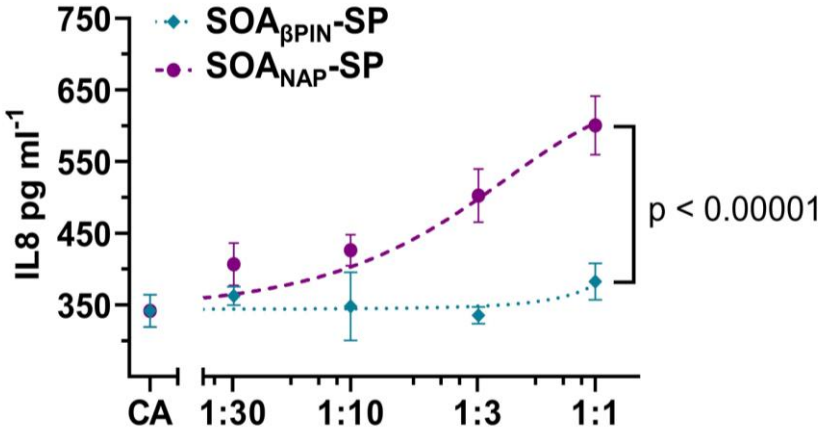
Effects of SOA_{NAP}-SP and $SOA_{\beta PIN}$-SP on A549 Monoculture











SOA_{NAP}-SP reduces metabolic activity and increases cytotoxic, genotoxic and inflammatory effects in lung epithelial cells

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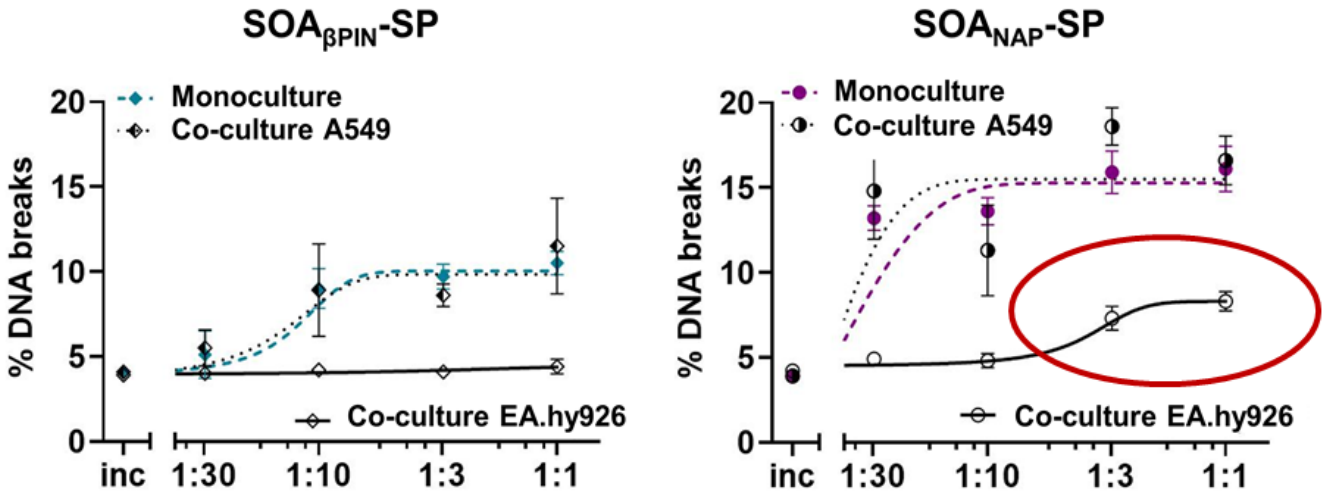
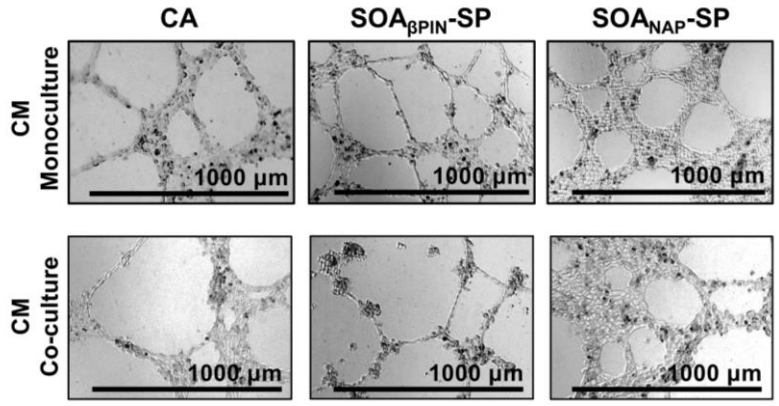
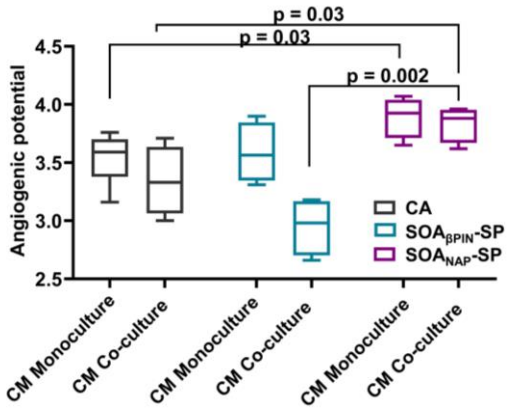
SOA_{NAP}-SP induces secondary genotoxicity in the EA.hy926 and foster angiogenesis



SOA_{NAP}-SP induces DNA breaks in EA.hy926 cells





Cross-activation of endothelial cells after the exposure to SOA_{NAP}-SP

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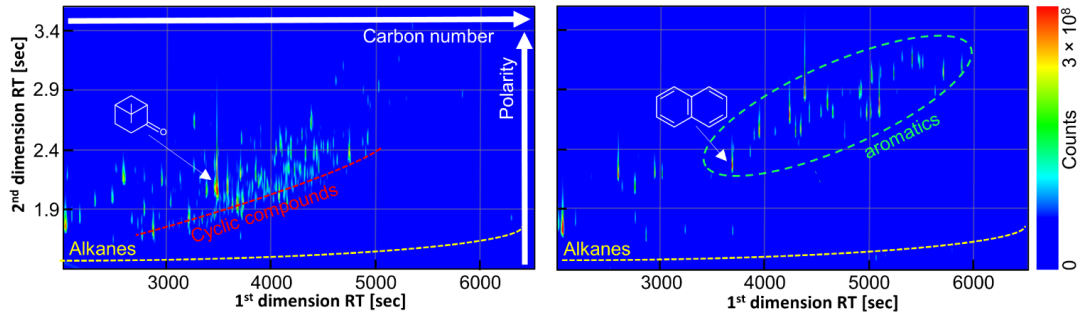
Chemical distinct differences

$SOA_{\beta PIN}$-SP	SOA_{NAP}-SP

3.6 µmol m^{-3}	ROS online monitor H_2O_2-equivalent	14.1 µmol m^{-3}
0.61	AMS O/C ratio	0.77

TD-GC×GC-TOFMS



H_2O_2-equivalent:
SOA_{NAP}–SP with higher oxidative potential
→ Same trend for MDA analyses (cellular oxidative stress)

AMS
O/C values: higher photochemical oxidation of **SOA_{NAP}–SP**

TD-GC×GC-TOFMS:
$SOA_{\beta PIN}$–SP dominated by oxygenated cyclic and acyclic compounds (i.e. Nopinone)
SOA_{NAP}–SP dominated by aromatic structures (ring-retaining and ring-opening aromatic compounds)

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