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MASS

- fundamental and intrinsic property
- traceable to first principles
- 3-dimensional metric
→ sensitive to changes



How heavy is a carbo-nanotube?
Nanoparticle - named after a length, but traded in €/kg, grams, big bags, ...



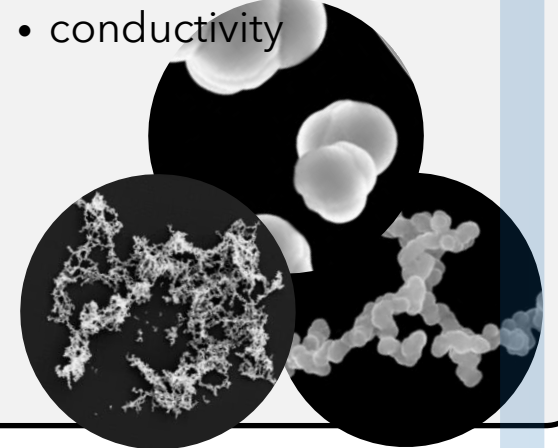
DIAMETER

- 1-dimensional metric
- depends on **geometry** ...
- hydrodynamic diameter (DLS)
- mobility diameter
- ... and **density**...
- stokes diameter (centrifugal photo-sedimentation)
- ... and **refractive index**.
- laser diffraction



STRUCTURE

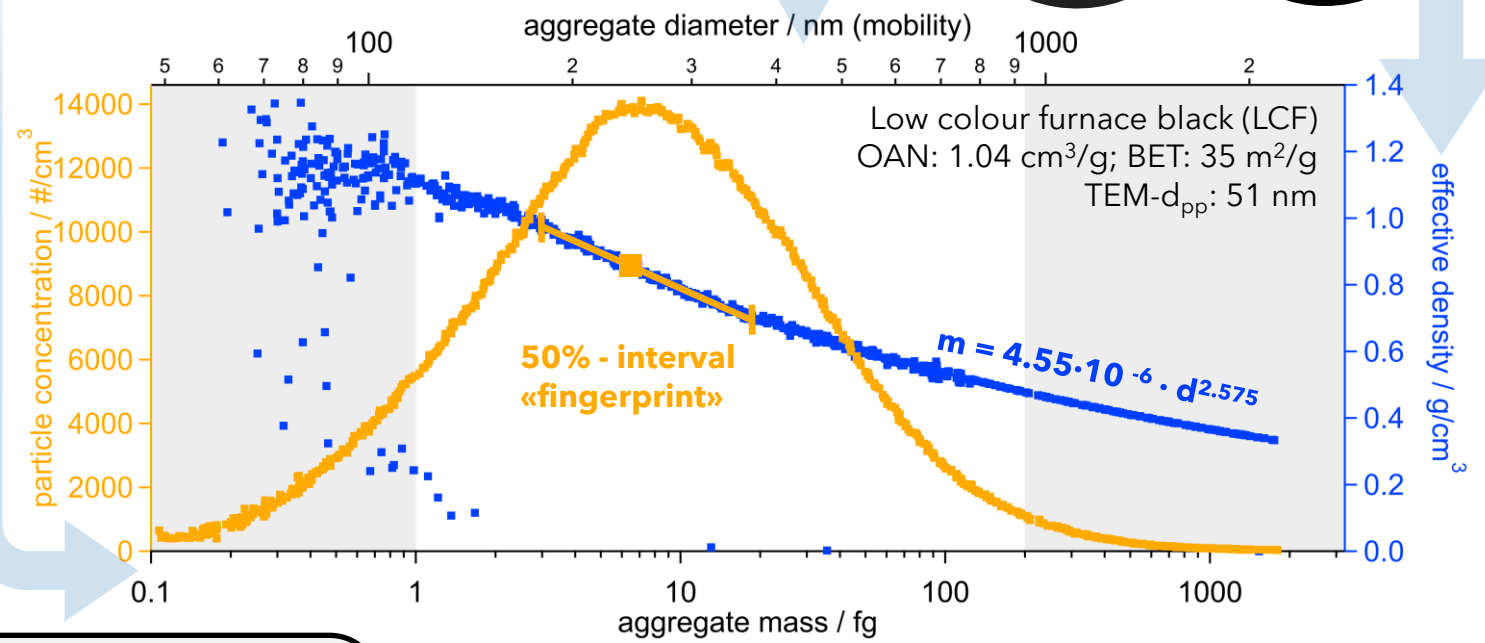
- aggregation level
- rubber-reinforcement
- conductivity



femtoG analysis of carbon black

- 8-12 min per scan;
- 600+ data points
- 10-50 mio particles counted
- continuous sampling
- instrument easy to clean

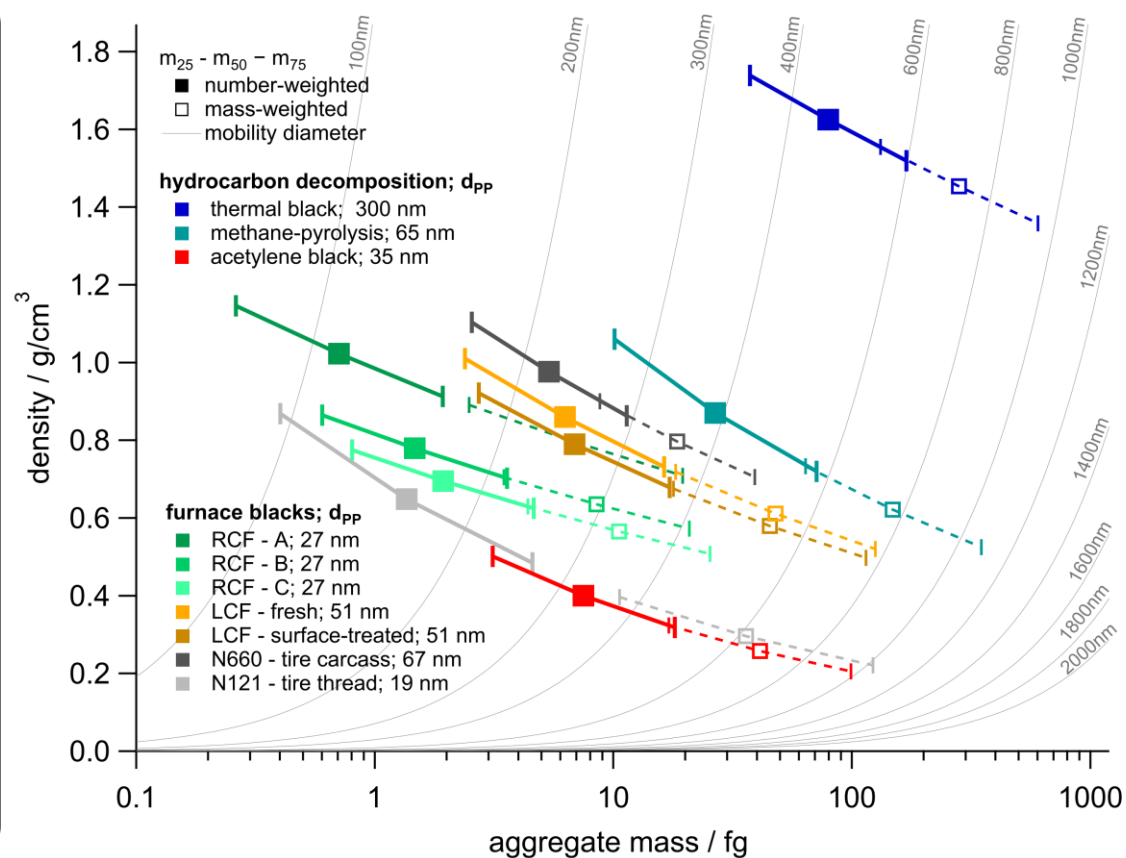
→ high throughput
→ online process monitoring



Aggregation level - regular colour furnace black

TEM-imaging + oil absorption number	number of aggregates/gram	single layer of aggregates
RCF-A; OAN: 0.68 cm ³ /g d _{pp} : 27nm	4.6 · 10 ¹⁴ /g	11.2 m ² /g
RCF-B; OAN: 1.08 cm ³ /g d _{pp} : 27nm	2.8 · 10 ¹⁴ /g	9.7 m ² /g
RCF-C; OAN: 1.28 cm ³ /g d _{pp} : 27nm	2.2 · 10 ¹⁴ /g	9.1 m ² /g

mass = 2.30 · 10⁻⁶ · dia^{2.692}
mass = 1.97 · 10⁻⁶ · dia^{2.688}
mass = 1.99 · 10⁻⁶ · dia^{2.671}



1. Sampling

a) from reactor:

- dilution
- cooling
- drying

b) powder

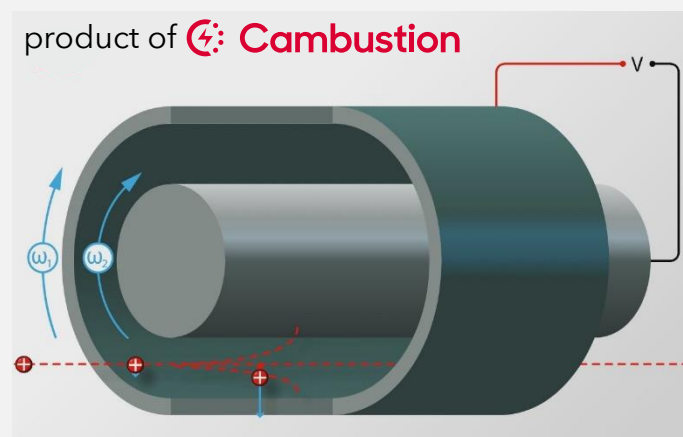
- dry-dispersion

2. Deagglomeration

- venturi-nozzles
- adjustable deagglomeration intensity
- shear: 100-500 N/m²
- force: 5 · 10⁻¹⁰ N / particle

3. Centrifugal particler mass analyzer

- selection by mass to charge ratio



4. Particle sizing

- mobility to size ratio

