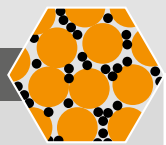
Heraeus

THE CARBON ADDITIVE ROADMAP

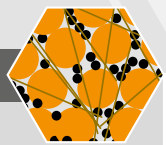
State-of-the-art



• Carbon Black

- **Primary Particle Diameter:** Tens of nanometer
- **Aggregate Size:** Hundreds of nanometer
- **Rheology:**
  - (−) High shear forces needed to break aggregates
- **Within the Electrode:**
  - (+) Provides short distance electronic path
  - (+) Contributes to micro- and mesoporosity
  - (−) Obstructs macroporosity

Upcoming



▪ Carbon nano fibers (CNF) and Carbon nano tubes (CNT)

- Diameter 15 nm CNT – 150 nm CNF
- Length 3 – 8 µm up to 100 µm
- **Rheology:**
  - (−) High shear forces needed to break aggregates
- **Within the Electrode:**
  - (+)(+) Provides middle to long distance electronic path
  - (+) Contributes to micro- and mesoporosity
  - (−) Obstructs to a lesser extent macroporosity
  - (−) High shear forces
  - (−) Potentionally toxic

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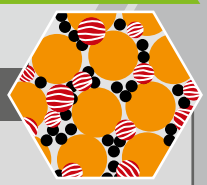

• Porocarb®

- Diameter of particles in tunable range of micrometer
- **Rheology:**
  - (+) No aggregation and easy to disperse
- **Within the Electrode:**
  - (+)(+) Creates ionic and electronic conductive pathways
  - (+) Provides defined meso- and macroporosity
  - (+) Maintains open porosity
  - (+) Non-toxic

Porocarb®

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