SYNOPSYS®

From 3D Images to Simulation with Simpleware and COMSOL

Simpleware software provides solutions for generating high-quality models from 3D image data (MRI, CT, micro-CT, FIB-SEM…) for direct export to COMSOL Multiphysics© software. This solution is smooth and robust for workflows using complex image data, and opens up a wide range of applications for COMSOL users needing a straightforward route from scan to CAD, FEA and CFD models that represent real world geometries.

Simpleware Key Benefits

- Industry-leading finite element mesh quality
- Fast and time-saving workflow
- Dedicated COMSOL Multiphysics© export (.mph and .mphtxt)
- Work with wide range of 3D image data and CAD files
- Easy-to-use and intuitive interface
- Customizable, including scripting
- Extensive technical support and consulting services

Simpleware Features

- Automated multi-part meshing for structural FEA and CFD
- Fix models (dirty CAD, orphan/ deformed meshes, Booleans…)
- Rapid image data visualization and animation in 2D and 3D
- Comprehensive image processing & analysis tools
- CAD integration & NURBS (IGES) export
- FE-based homogenization modules
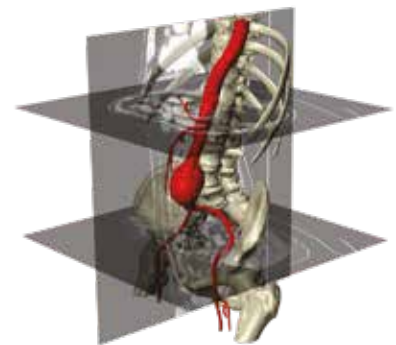
Selection of Application Areas for COMSOL Multiphysics© Users

- **Life Sciences**
  e.g. medical devices, orthopedics, physiological flows…

- **Materials Science**
  e.g. alloys, composites, soils, concrete, porous media, plastics, rubbers…

- **Reverse Engineering**
  e.g. automotive, aerospace, consumer and legacy products…

- **Industrial NDT**
  e.g. product design, industrial filters, fuel cells, batteries, welds…

- **Oil & Gas**
  e.g. digital rock physics, special core analysis, geophysics field data…

- **Synthetics**
  e.g. textiles, ceramics, insulation materials, fibres…
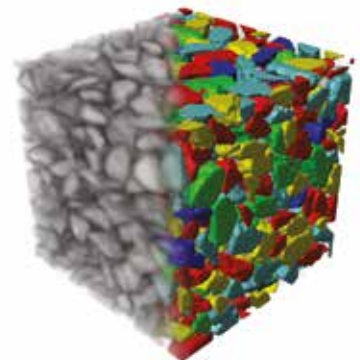
Effects of Porosity on the Elastic Properties of Synthetic Graphite

G. Sowa • R. Paul • R. Smith
*GrafTech International, Parma, USA*
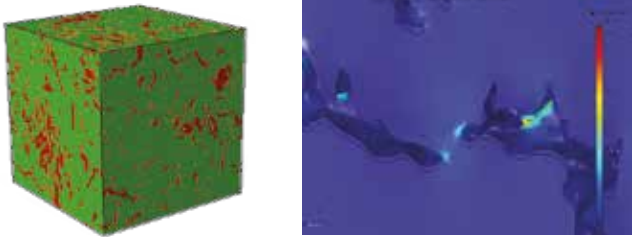
3D model of pores (red) and close-up of pore stress concentration in COMSOL

Graphite is a versatile material used by GrafTech for solutions in applications such as thermal management and insulation. This study looks at the effects of porosity on the elastic properties of synthetic graphite. Industrial CT images of synthetic graphite were imported into Simpleware for visualization, measurement and segmentation into solid and porous regions. A simulation-ready mesh was generated and imported to COMSOL Multiphysics®, where tests were successfully carried out into how different degrees of porosity affect stress concentration in graphite. The results provide valuable insight into the behavior of synthetic graphite as a complement to experimental testing.

Influence of Single Particle Structure on Lithium Ion Battery Performance

L. Nowack • T. Bunjaku • M. Luisier • V. Wood
*ETH Zurich, Zurich, Switzerland*
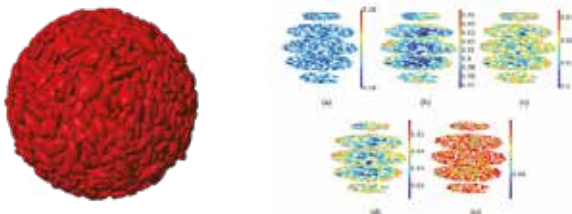
Microspherical particles in Simpleware ScanIP and simulation results in COMSOL

Lithium ion diffusion in the active material is one of the limiting factors in lithium ion batteries. This study demonstrates template-assisted spray drying as a method to assemble nanoparticles into microspheres with controlled size, porosity, and hierarchical structure. Microspherical particles were created in MATLAB® before being voxelized, segmented and meshed in Simpleware. Single particle simulation in COMSOL provided insights into how changes in particle size and porosity influence the charging and discharging behavior of single lithium ion battery particles. This work has significant potential for better understanding how batteries can be optimized depending on their application.

Direct Current Stimulation (tDCS) across Skull Defects

A. Datta [2] • M. Bikson [1, 2]
[1]City College of New York of CUNY, New York, USA   [2]Soterix Medical, New York, USA
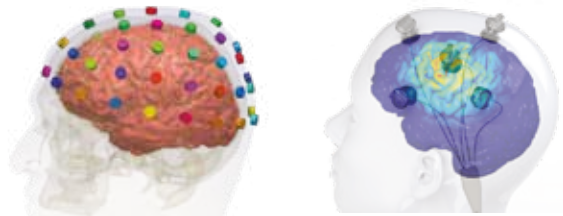
Electrode placement in Simpleware CAD and current distribution in COMSOL

This research investigates how tDCS can help patients with neuropsychiatric conditions and skull defects. In this project, MRI images of the skull were imported to Simpleware for visualization, segmentation and integration with CAD models of stimulation pads. The models were exported as multi-domain meshes to COMSOL to gain insights into how current distribution might affect the neurological responses of different patients. The findings help researchers to improve their understanding of how tDCS can be safely applied to different parts of the brain for specific patients. The work carried out by CCNY is used by Soterix Medical to develop medical devices suitable for a wide range of applications.

Simpleware Software Solutions

The Simpleware product group at Synopsys develops software for the conversion of 3D scan data (MRI, CT, micro-CT...) into high quality design, simulation and 3D printing models. Simpleware software is used in fields such as the Life Sciences, Materials Science, Industrial Reverse Engineering, NDE, and Oil and Gas. Easy-to-learn and use, the software offers a robust bridge between the latest imaging technologies and multiple design and simulation applications.

For more information go to www.simpleware.com

Synopsys (N.E.) Ltd
Bradninch Hall, Castle Street
Exeter, Devon
EX4 3PL, UK

International Sales: +44 (0)1392 428 750
U.S. Sales: +1 (443)-741-3327
India Sales: +91 (0)820-9681120
Email: simpleware@synopsys.com

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