



## **Microstructure characterization and property evaluation of cement-based materials using micro-CT**

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The microstructures of cement based materials are complex, and their characteristics significantly affect material properties. As micro-CT becomes more readily available, investigation of 3D microstructures of cement-based materials using micro-CT has been gaining its momentum. Unlike other imaging approaches such as SEM or TEM, the micro-CT is the only method that can obtain complex 3D microstructures of materials in a non-destructive approach. Through careful image analysis of microstructures obtained from micro-CT, pore and solid microstructures can be characterized. Among microstructure characterization approaches, the random pore microstructures have been found to be effectively characterized by low-order probability functions. The low order probability functions are also used to reconstruct two-phase (pore/solid) cement paste microstructures through a stochastic optimization process, which generates statistically identical microstructures having the same probabilistic descriptions of random microstructural features. Whether the microstructures are directly obtained from real specimens using micro-CT or reconstructed from probability functions, the virtual microstructures can be further used to evaluate material properties using virtual experiments. Through simulations using virtual specimens, evaluations of material properties such as permeability /diffusivity, thermal conductivity, and mechanical responses (stiffness and strength) are possible. The real experiments can be synergistically combined with simulations, which can be used to extract correlations between microstructural characteristics and evaluated properties of cement-based materials. The combined framework of experiments and simulations should help accelerated development of new innovative materials and accurate performance evaluation of existing materials.