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Research progress in advanced nanomechanical characterization of cement-based materials

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Abstract: Advanced characterization techniques have provided powerful tools for characterizations of materials at micro- and nano-scales worldwide. Although some overviews on nanomechanical characterizations of cement-based materials have been published, they have often focused on nanoindentation. Very limited reviews have been reported on the applications of modulus mapping, PeakForce quantitative nanomechanical mapping, and nanoscratch for researches on the micro and nanoscale compositions, structures and mechanical properties of modern cement-based materials. This paper is aimed at filling this blank. Based on an extensive literature review and authors' own experience, the basic knowledge (e.g., general concepts, developments, and progresses) involved in the state-of-the-art nanomechanical characterization techniques have been systematically summarized in this paper. The critical issues (e.g., sample preparation procedures and requirements, measurements, and data analysis methods) of these techniques have been discussed in details. The applications of these techniques, especially their suitability for critical characterization of different scales of interfaces of cement-based materials are compared. Finally, the future perspectives of these nanomechanical characterization techniques are highlighted. It is expected that the outlook of this paper can help future researchers make scientific justification on selection of nanomechanical characterization methods and steer inquisitive readers into substantial details that may lead them to successful applications of these advanced techniques.

Keywords: Nanomechanical characterization; Nanoindentation; Modulus mapping; PeakForce quantitative nanomechanical mapping; Nanoscratch

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