



岩土力学与工程前沿讲坛

Forum on Geomechanics and Geo-engineering

No.SK2021-20

应岩土力学与工程国家重点实验室邀请，美国麻省大学阿姆赫斯特分校张国平教授来实验室进行线上学术交流并讲学，报告信息安排如下：

报告人
Lecturer

张国平 教授

报告题目
Theme

**An Atomistic Perspective on Alkaline Activation:
From Geopolymerization and Soil Improvement to
Superhydrophobicity and Beyond**

报告时间
Time

2021 年 12 月 25 日 (周六) 上午 09:30

报告地点
Spot

腾讯会议号：721 475 539

欢迎广大科研人员及研究生参加！

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报告摘要

An atomistic perspective on alkaline activation, the common kernel to geopolymerization, pozzolanic reactions, lime/cement-stabilized soft clays, hybrid lime-clay-starch nanocomposites (三合土), superhydrophobic polysiloxanes, and more generally Portland cements, is reviewed and discussed, with a particular emphasis on the amphoteric properties of heterogeneous surfaces of being-activated materials (e.g., kaolinite and metakaolin) and resulting changes in the structures of molecules and molecular clusters (e.g., SiQ(mAl) , AlQ(nSi) , and SiT(xAl)). Key concepts being discussed consist of: (1) amorphization that transforms crystalline kaolinite to the amorphous counterpart, as evidenced by the disappearance of 6-fold Al (AlVI) but emergence of 5-fold Al (AlV) in metakaolin; (2) dissolution in alkaline solutions that leads to reactive monomers such as silanols and Na-aluminols or non-soluble CSH/CASH/CAH, the latter of which can cover the activated clay mineral surface and hence prevent further dissolution but the formation of interparticle cementation (i.e., macroscopic strengthening); (3) condensation that results in the inorganic siloxane (-Si-O-Si-) and/or aluminosiloxane (-AlIV-O-(Si-O)_z-) network, the backbone for geopolymers and other bonding agents; (4) hydrolysis induced by broken bonds of mineral surfaces and reactive silanes, the latter of which opens a new door for functionalization of purely inorganic Al-silicates; and (5) hybridization via hydrogen and covalent bonds that serves as an example for multi-functionalization of traditional construction/civil engineering materials such as superhydrophobicity. The synopsis of these concepts makes up the heart of alkaline activation and pertinent technological applications. Selected, essential, signature results from our own work and published literature including X-ray diffraction, microscopy, small-angle X-ray scattering, chemical analysis, and nuclear magnetic resonance, among others, are used to illustrate the aforementioned concepts and the underlying sciences (i.e., physics, chemistry, and reaction mechanisms), together with some macroscopic behavior and engineering properties for broader audience. This seminar aims to deliver to the geotechnical engineering community the integrated knowledge and experience of the speaker gained through >15 years of continuous R&D in geopolymers and clay minerals. [*The speaker only received limited rudimentary education in chemistry at middle and high schools, but not colleges, so the contents should be fairly understandable to everyone*]

报告人介绍



Guoping Zhang is currently a professor in the Department of Civil & Environmental Engineering at the University of Massachusetts Amherst. He obtained a PhD in Geotechnical Engineering with a minor degree in Materials Science and Engineering from MIT in 2002. His research is centered on clay-based and clay-derived materials, including clay minerals, clay-biopolymer aggregates and flocs, shales, geopolymers, and superhydrophobic materials, as well as their property (mainly mechanical) characterization

and applications, with funding from a variety of federal, state, and industrial sponsors.