Polytech network form for PhD Research Grants from the China Scholarship Council

This document describes the PhD subject and supervisor proposed by the French Polytech network of 14 university engineering schools. Please contact the PhD supervisor by email or Skype for further information regarding your application.

Supervisor information	
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Country	France

PhD information	
Title	Self-damping properties of smart concrete
Main topics regards to CSC list (3 topics at maximum)	Stiffness, durability and sensing properties; safer energy production

Required skills in science and engineering	A high level in computer science, concrete properties

Subject description (two pages maximum)

There is an urgent need for a new sustainable cement technology that can minimize the environmental damage caused by cement production and offer new products with better stiffness, durability and sensing properties for safer energy production. Thanks to the development of nanoscience and nanotechnology in civil engineering sector, research gets the potential to engineer the future generation of smart nano-engineered cementitious composites.

Concrete is inherently poor in damping ability, but it can be enhanced with incorporating some admixtures (polymer latex, silica fume (SF), methylcellulose (M), fiber, and/or graphite sheet, etc.). Since 1990s, researchers began to try to improve the damping property of concrete by adding macromolecular materials. A series of studies have been handled to improve the damping property and stiffness of concrete using admixtures such as SF and latex . Research considered low interfacial shear strength between the fibers and the matrix and high interfacial area will lead to an increase in damping capacity.
Compared with the conventional concrete, selfdamping concrete possesses the advantages of vibration reduction and hazard mitigation of bridges, buildings, and other civil infrastructure systems. However, there are also many aspects needed to be improved, for example, storage modulus, chemical stability, and durability of the resultant damping systems.

Nano-engineering, or nanomodification, of cement is a quickly emerging field. It encompasses the techniques of manipulation of the structure at the nanometer scale to develop a new generation of tailored, multifunctional, cementitious composites with superior mechanical performance and durability potentially having a range of novel properties. Concrete can be nano-engineered by the incorporation of nanosized building blocks or objects (e.g., nanoparticles and nanotubes) to control material behavior and add novel properties.

To improve the traditional behavior of cement, it is essential to explore the properties of the nanogranular binding phase of the cement, called the Calcium–Silicate–Hydrate (C–S–H). While C–S–H gel has reached significant level of understanding under a number of varying conditions, cement nanoscience is looking for the future by studying the effects of the ingress of foreign

nanomaterials into the C–S–H nanostructure.

We aim, first, to study deeply the new generation of nano-engineered cementitious composites (NECC) by incorporating to calcium silicates hydrates (C-S-H) nanostructure different kind and geometries of nanoparticles (nanp-oxides, nano-montmorillonite clays and carbon buckyballs). We project to study essentially the open questions of the dispersion, the density, the interfacial shear strength between nanomaterials with C-S-H and how they can fill the pores, affect the degree of hydration and can reduce the compressive strength.
Then, we plan to *study of the vibrationals variations of NECC under various concentrations of nanomaterials, external loading and environmental changes*