

Popular science summary of the PhD thesis

PhD student	Peng Jin
Title of the PhD thesis	Multifunctional Smart Construction Materials via Advanced Fabrication Technology: From Cement and Industrial Waste to Living Building Materials
PhD school/Department	Department of Civil and Mechanical Engineering

Science summary

* Please give a short popular summary in Danish or English (approximately half a page) suited for the publication of the title, main content, results and innovations of the PhD thesis also including prospective utilizations hereof. The summary should be written for the general public interested in science and technology:

This Ph.D. project explores next-generation building materials that offer more than structural support—they can store energy, detect cracks, and even de-ice surfaces.

First, the research develops a cement-based material that includes a 3D-printed conductive framework and carbon black, aiming to endow the matrix with good conductivity. Subsequently, conducting polypyrrole (PPy) film is deposited onto the surface via an electrochemical method. The PPy coating works together with the conductive matrix, enabling multiple functions. To reduce environmental impact, cement is replaced with geopolymer made from industrial waste-fly ash, activated by an alkaline activator. This eco-friendly material, coated with poly(3,4-ethylenedioxythiophene) (PEDOT) via a hydrothermal process, shows excellent energy storage performance. The final innovation of this project is to create a living building material (LBM) using 3D-printable hydrogel loaded with bacterial cells. These microbes help strengthen the material via urea hydrolysis and mineral precipitation. The LBM is then coated with PEDOT/carbon nanotube (CNT) to allow it to store energy too.

Overall, this work shows how future buildings can be made more sustainable and smarter by combining material science, advanced fabrication technology, and biology.



Please email the summary to the PhD secretary at the department