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Graphene Reinforced Concrete

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The constant need for improvement of strength, ductility and durability of concrete is driving current research efforts towards improving the overall strength of concrete by nano-engineering its chemical and mechanical properties through reinforcement with nanomaterials. Graphene, an atomically thin layer of carbon, has a large specific surface area, high Young's modulus, high thermal conductivity and excellent electrical conductivity. These properties make graphene one of the most prominent nanomaterial for applications in concrete reinforcement.

Methodology: We report a novel method of increasing the overall compressive strength of concrete with the addition of defect-free, water-stabilised graphene dispersions. We demonstrate that the high-shear exfoliation of graphene in water is extremely efficient for the fabrication of graphene reinforced concrete as it can substitute water directly in the concrete mixture and it is industrially scalable.

Findings: Through a comparative statistical study of the mechanical properties of graphene reinforced and standard concrete we demonstrate that graphene reinforcement increases the strength of early age concrete by up to 18.6 %. Furthermore, our results show that the incorporation of graphene into the concrete matrix increases the compressive strength of the fully cured concrete by 26.

Conclusion & Significance: Our results indicate that the increase in early age compressive strength can contribute towards the urbanisation demands of constructing taller buildings by reducing the required time for keeping the formworks on construction sites, as well as by excluding the addition of chemical admixtures. A unique benefit is that unlike other nanomaterials, our method of production and final product are non-hazardous, making graphene reinforced concrete a promising material for a more environmentally friendly construction industry.

Biography

Dimitar Dimov is a PhD researcher in Nanoscience and Civil Engineering at the University of Exeter, UK. Dimov has completed his BEng in Civil Engineering at Exeter and then was invited straight away to pursue a PhD degree after receiving the award for best individual research project (83%) during his final year of undergraduate. His current work bridges the international research on two-dimensional materials with traditional composite structural materials like concrete. The primary focus is to investigate the chemical and physical alterations of the cement hydration crystals upon the addition of nanomaterials.

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