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Editorial: Innovative Use of FRP and Nanofiber-Based Materials in Engineering

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Editorial on the Research Topic

Innovative Use of FRP and Nanofiber-Based Materials in Engineering

Advanced structural materials have been extensively developed to produce engineering structures with sensing capabilities and adaptive response to external actions. As one of the most promising research topics, it attracts high attention. These fiber-reinforced polymer (FRP) and nanofiber-based enhanced structural materials have been particularly studied to explore their innovative uses in civil engineering, aerospace projects, ocean infrastructure, and so on. Smart materials are further required to control the structures in applicable states and to enhance the structures with self-healing properties. Materials with these advanced functions hold great potential to configure smart components and smart structures. Based on peer reviews, 7 articles have been collected to showcase the recent progress in the fields of advanced structural materials, smart sensors and structures. In comparison to conventional materials, fiber-reinforced polymer (FRP) and nanofiber-based materials can be designed to configure smart sensors and components, which can improve the strength, bearing capacity, durability, self-sensing and self-healing functions of structures during their life cycle. For example, the combination of optical fiber and FRP can be used to establish smart FRP components, which can strengthen the key parts of a large project and monitor the *in-situ* mechanical performance of reinforced structures. The combined FRP and nanofiber can be used to enhance the interfacial bonding strength of the multi-layer FRP laminates. The combined optical fiber and nanofiber can be adopted to develop optical fiber sensors with versatile functions, which can have extensive use in measurement fields. Meanwhile, both optical fiber sensors and smart CFRP-FBG composites can be separately developed to measure the structural response and provide the self-sensing capability of the structure. The practical deformation and the performance degradation of the structures in the service period can be recorded by smart sensors, which can be used to predict the working state and the potential failure modes.

It is a promising field to use the advantages of these advanced materials to realize smart structures with multiple functions. Although an increasing amount of research has been conducted, challenges and engineering demands remain, calling for further innovative exploration. Therefore, this research topic will focus on the latest advances in theories, concepts, mechanisms, models and practices of smart structural materials, addressing the challenging use of FRP and nanofiber-based materials and components in the application of intelligent infrastructures. This research topic aims to cover original or review articles referring to innovation in smart materials and structures. Themes of interests include, but are not limited to:

- FRP components and structures to check the reinforcing effect and bearing capacity of the base structures
- Self-sensing materials and structures to measure the parameters, such as stress (or force), strain (or deformation), crack, damage, temperature, and pressure
- Self-healing materials and structures with the ability to repair microdamage (cracks and interfacial debonding) autogenously or autonomously
- Nanofiber based materials with the ability of effectively improving the structural performance
- Optical fiber sensors and components in engineering
- Smart materials and structures with both self-sensing and self-healing functions

Based on the above information, the research topic includes 7 articles. The general titles and the hyperlinks of the articles are listed as below:

(1) *Dynamic Performance Detection of CFRP Composite Pipes based on Quasi-Distributed Optical Fiber Sensing Technique*s (Wang et al.)
(2) *Analysis of Anomalous Dynamic Responses of Fiber Metal Laminates Under Pulse Loading* (Zhai et al.)
(3) *Effective Strain of BFRP for Confined Heat-Damaged Concrete Cylinders* (Ouyang et al.)
(4) *Flexural Behavior of Simply Supported Beams Consisting of Gradient Concrete and GFRP Bars* (Ji et al.)
(5) *High Temperature Exposure Assessment of Graphene Oxide Reinforced Cement* (Yan et al.)
(6) *Bearing Capacity of Hollow GFRP Pipe-Concrete-High Strength Steel Tube Composite Long Columns Under Eccentrical Compression Load* (Ji et al.)
(7) *Seismic Behavior of GFRP Tube Reactive Powder Concrete Composite Columns with Encased Steel* (Ji et al.)

Five contributed articles explore the application of FRP based composites for structural materials in civil engineering, with the dynamic performance, effective strain, flexural behavior, bearing capacity and seismic behavior discussed, respectively. Finite element analysis based on ABAQUS software has been conducted to simulate mechanical performance. Optical fiber sensing technology has also been adopted to investigate the special function of the innovative FRP components in engineering. Several useful conclusions have been given to instruct the optimum design, efficient operation and condition assessment of FRP configured structures. Additionally, one article investigates the anomalous dynamic response of fiber metal laminates subjected to impulsive loading, which can instruct the design of fiber metal laminates under extreme loadings. Another article experimentally assesses the structural performance of graphene oxide reinforced cement exposed to high temperatures (200, 400, 600, and 800°C). All these articles comprise the research topic, and have declared the recent progress of smart FRP and nanofiber-based materials and structures in engineering. It is expected that this topic can deliver useful information for researchers in the fields of structural materials, optical fiber sensors, and engineering structures.

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H-PW drafts the Editorial, W-YG, PX, and YB give instruction.

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