Understanding the self-sensing behaviour of cementitious composites with the addition of nitrogen-doped graphene and oil refinery waste catalyst (SENSOR)

Infrastructure is the set of public facilities and systems that serve a country. It is made up of roads, railways, bridges, tunnels, etc. Concrete is the most commonly used material to construct these heavy civil structures. A well-designed and well-maintained infrastructure helps the society grow and reduces the loss of human life due to natural or man-made disasters. Advances in sensors and information technologies have brought structural health monitoring as a data-driven remedy for the safety of civil infrastructure. In the past two decades, smart and mobile sensor systems have taken the discipline of structural health assessment to a new era, but they have their own drawbacks in the construction field, including being less durable, being very expensive, and not being consistent over time. Scientists recently found that concrete can serve as both a structural material and a sensor if engineered using carbon nanomaterials.

A promising method to improve the self-sensing potential of concrete is engineering with graphene. It is an allotrope of carbon and the thinnest material ever discovered. It has commercial applications in the fields of seawater desalination, electric vehicles, and computers. Many forms of graphene are available on the market. The graphene doped with nitrogen atoms is regarded as the best electrode material. Until now, scientists have never engineered concrete with nitrogen-doped graphene. However, concrete production is a huge energy burden on the environment, its pollution, and the excessive consumption of natural resources. Nowadays, solid waste disposed of by the coal and steel industries is used in concrete production to reduce this energy burden. Solid waste disposed of by the petroleum industry is typically used in landfills. Its application in concrete production improves strength and durability, but is not preferred because of the presence of traces of hazardous elements. However, these elements may have the potential to enable self-sensing behavior in concrete, which will be investigated by scientists from Wroclaw University of Science and Technology.

It is possible to obtain really sustainable concrete that is cheap, durable, environmentally friendly, and self-sensing on a commercial scale by engineering with both graphene nanomaterial and oil refinery solid waste. In collaboration with Technische Universität Darmstadt in Germany, a systematic experimental program will be developed to analyze the self-sensing properties of concrete qualitatively and quantitatively. This research group will also support the project in all areas related to application of graphene related materials in cementitious binder.

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