Smart paint could revolutionize structural safety

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Dr Mohamed Saafi with a prototype of the smart paint technology. Credit: University of Strathclyde

An innovative low-cost smart paint that can detect microscopic faults in wind turbines, mines and bridges before structural damage occurs is being developed by researchers at the University of Strathclyde in Glasgow, Scotland.

The environmentally-friendly paint uses nanotechnology to detect movement in large structures, and could shape the future of safety monitoring.

Traditional methods of assessing large structures are complex, time consuming and use expensive instrumentation, with costs spiraling into millions of pounds each year.

However, the smart paint costs just a fraction of the cost and can be simply sprayed onto any surface, with electrodes attached to detect structural damage long before failure occurs.

Dr Mohamed Saafi, of the University's Department of Civil Engineering, said: "The development of this smart paint technology could have far-reaching implications for the way we monitor the safety of large structures all over the world.

"There are no limitations as to where it could be used and the low-cost nature gives it a significant advantage over the current options available in the industry. The process of producing and applying the paint also gives it an advantage as no expertise is required and monitoring itself is straightforward."

The paint is formed using a recycled waste product known as fly ash and highly aligned carbon nanotubes. When mixed it has a cement-like property which makes it particularly useful in harsh environments.

Dr Saafi explained: "The process of monitoring involves in effect a wireless sensor network. The paint is interfaced with wireless communication nodes with power harvesting and warning capability to remotely detect any unseen damage such as micro-cracks in a wind turbine concrete foundation.

"Wind turbine foundations are currently being monitored through visual inspections. The developed paint with the wireless monitoring system would significantly reduce the maintenance costs and improve the safety of these large structures.

"Current technology is restricted to looking at specific areas of a structure at any given time, however, smart paint covers the whole structure which is particularly useful to maximise the opportunity of preventing significant damage."

The research has been carried out at Strathclyde with Dr Saafi working alongside David McGahon, who initiated the work as part of his PhD project. With fly ash being the main material used to make the paint, it costs just one percent of the alternative widely used inspection methods.

A prototype has been developed and tests have shown the paint to be highly effective. It is hoped further tests will be carried out in Glasgow in the near future.

Dr Saafi added: "We are able to carry out the end-to-end process at the University and we are hoping that we can now demonstrate its effectiveness on a large structure.

"The properties of the fly ash give the paint a durability that will allow it to be used in any environment which will be a massive advantage in areas where the weather can make safety monitoring particularly difficult.

"The smart paint represents a significant development and is one that has possibly been overlooked as a viable solution because research tends to focus on high-tech options that look to eliminate human control. Our research shows that by maintaining the human element the costs can be vastly reduced without an impact on effectiveness."

Provided by University of Strathclyde

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