Wireless nano sensors could save bridges, buildings

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Could inexpensive wireless sensors based on nanotechnology be used to alert engineers to problematic cracks and damage to buildings, bridges, and other structures before they become critical? A feasibility study published in the *International Journal of Materials and Structural Integrity* would suggest so.

Mohamed Saafi of the Department of Construction Engineering and Management, at North Dakota State University, in Fargo, and colleagues at the National Institute of Applied Sciences, in Tunisia, together with a team at the Department of Engineering Technology, at Alabama A&M University, point out that civil structures are prone to continuous and uncontrollable damage processes during their designed service lifespan. These damaging processes might be due to weather, aging of materials, earth tremors, and a lack of maintenance.

A continuous monitoring system is needed to improve safety. Unfortunately, the costs and required time expenditure often mean monitoring is not carried out in a timely manner and trivial problems, such as small cracks and fissures, ultimately become serious conditions that threaten the integrity of a structure. The researchers suggest that nanotechnology and wireless systems could be the answer.

As a proof of concept, the researchers have developed and evaluated two types of wireless devices for the remote monitoring of concrete structures. The devices are sensors based on microelectromechanical systems, MEMS, and were designed to monitor temperature and

moisture within the concrete. Long gauge nanotube sensors were employed for crack detection in the feasibility study. MEMS and nanosensors have already been used in a wide range of engineering and science fields such as transportation, communication, military and medicine. Their use in civil engineering is a new application with great potential.

"If designed properly, wireless MEMS and nanotechnology-based sensors could be used as embedded components to form self-sensing concrete structures," the team explains. Such devices would gather and transmit information about the health of a structure by detecting the early formation of tiny cracks and measuring the rate of key parameters, such as temperature, moisture, chloride, acidity and carbon dioxide levels each of which might reflect a decrease in structural integrity.

"Information obtained from such monitoring techniques would allow the owners to make critical decisions regarding operation, maintenance, repair and replacement under financial constraints," the team says.

More information: "Wireless and embedded nanotechnology-based systems for structural integrity monitoring of civil structures: a feasibility study" in International Journal of Materials and Structural Integrity, 2010, 4, 1-24

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