Ultra-Durable Concrete with Self-Sensing Properties

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BRIEF DESCRIPTION

Concrete is a major material component for transportation, energy, water, and building infrastructure systems. UCI researchers have developed a new class of concrete materials with extraordinarily high damage tolerance and improved properties for long-term health monitoring.

FULL DESCRIPTION

Concrete is the most heavily consumed manmade material on earth. It is used in all modern infrastructure, making the integrity and durability very important. Concrete is naturally quasi-brittle, being susceptible to cracking and fracture failure under combined mechanical loads and environmental effects. State of the art concrete formulations, such as fiber reinforced concrete (FRC), have increased fracture energy but fail to address the quasi-brittle nature of the material. Cracking and strain can significantly reduce the integrity of a structure, making early detection of damage very important. Current management solutions require visual inspections that are subjective and limited to accessible locations. Attempts at physics modeling, ultrasonic acoustics, and point-based sensors have proven too costly or too slow for widespread adoption.

UCI researchers have developed multifunctional cementitious materials (MSC) with greater durability and self-sensing properties. MSC is formulated to produce distributed microcracking under strain that maintain structural integrity, rather than localized fractures which weaken the concrete. The microcracks have another crucial role in self-sensing, as they produce measurable change in the electrical properties of the concrete. As a result, simple and inexpensive electrical measurements can be used to probe the health of the concrete structure. The durability and self-sensing properties of MSC can significantly reduce the long-term costs of monitoring and repairing essential infrastructure.

SUGGESTED USES

Structural concrete for infrastructure systems

ADVANTAGES

- Increased strength and durability
- Improved self-sensing ability for long-term health monitoring

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,891,335	02/06/2024	2017-985

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OTHER INFORMATION

CATEGORIZED AS

- **Materials & Chemicals**
  - Other
- **Sensors & Instrumentation**
  - Environmental Sensors
- **Engineering**
  - Other

RELATED CASES

2017-985-0

STATE OF DEVELOPMENT

Material has been developed and tested on the laboratory scale. Planned future steps involve evaluation of large-scale processing and performance.

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