Nanosensors in the Construction Industry

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Situation

- The size of nanosensors ranges between 1nm and 100nm and are usually made of carbon nanotubes.
- Nanosensors could be embedded into structures during construction.
- Nanosensors aid in the detection of cracks and defects in concrete, the detection of moisture and temperature variations of structures, and the reduction of physical labor [1].
- Different types of nanosensors include force, mass, temperature, and humidity nanosensors [2].

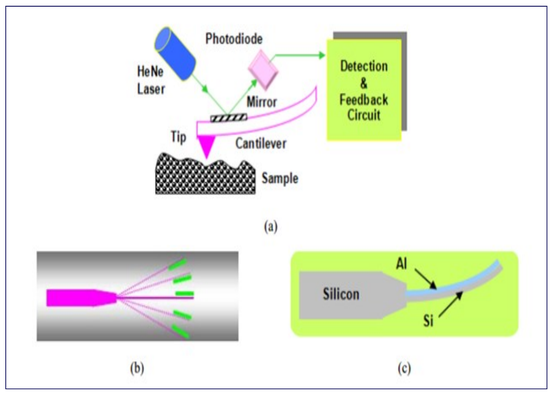

Figure 1: Different types of nanosensors [2].

Problems

- The cost of building prototype nanosensors can be quite high [3]. Designing and manufacturing nanosensors require skilled engineers and workers who require high wages.
- Exposure to nanoparticles might cause health threats to workers during manufacturing. Such threats include irritation of digestive and respiratory tracts as well as skin and eyes [3]. Workers can be affected through inhalation or direct contact with nanoparticles [4].

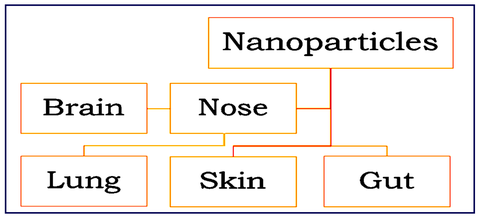

Figure 2: Hypothetical pathways of toxic nanoparticles [4].

- The small size and sensitivity of nanosensors cause handling difficulty. The wires that make up the nanosensors can be damaged if they are bent or exposed to high temperatures [5].
- Some of the materials that make up nanosensors may be incompatible with target materials [6]. Surface stresses could cause the geometry of the piezoelectric nanoplates to become unstable [7].

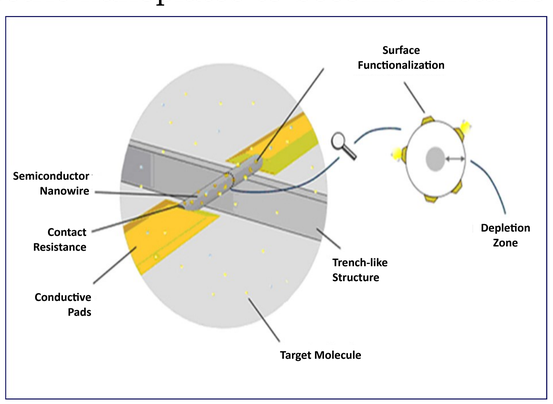

Figure 3: Nanosensors' compatibility with materials [8].

Solutions

- Nanosensor production in factories instead of in laboratories results in producing larger quantities which meet the high demand of nanosensors [6].
- Applying chemical treatment such as surface treatment, functionalization, or composite formation could reduce health threats [9].
- Embedding nanosensors into microsystems could protect nanosensors from harsh environments [10].
- The circular piezoelectric nanoplates can be made thicker and smaller in order to reduce the effect of surface properties [7].

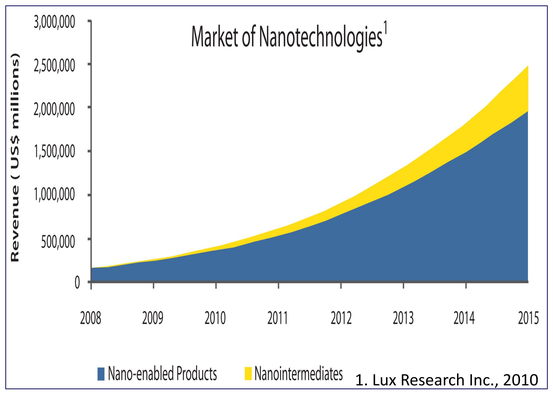

Figure 4: Market of nanotechnologies [11].

Evaluation

- The high cost of manufacturing nanosensors could be compensated for by reducing labor cost and producing nanosensors in factories at larger quantities than in laboratories.
- Chemical treatment can reduce the negative impact on the health of workers.
- Nanosensors function properly if embedded in larger microsystems which eliminates the problem of the handling difficulty.
- The molecules can be made compatible by making piezoelectric nanoplates thicker and smaller.

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