

Applications of Nano-coating in Engineering Disciplines

Nikita Karpov (CHE)

Ahmed Elhabil(MCE)

Mohamad Najib (CVE)

Ahmed Al Alami (MCE)

Situation

- The most common ways by which smartphones get damaged by liquid are rain (35%), spilled drink (26%), toilet (17%) and shower (11%) [1].
- Almost all mechanical parts that undergo rotational motion are over constrained by means of using materials with very high ultimate stresses as a precautionary method to avoid sudden fatigue [2].
- In the USA, 58% of carbon monoxide, and 35% of nitrogen oxides of the air are produced in roads [2].

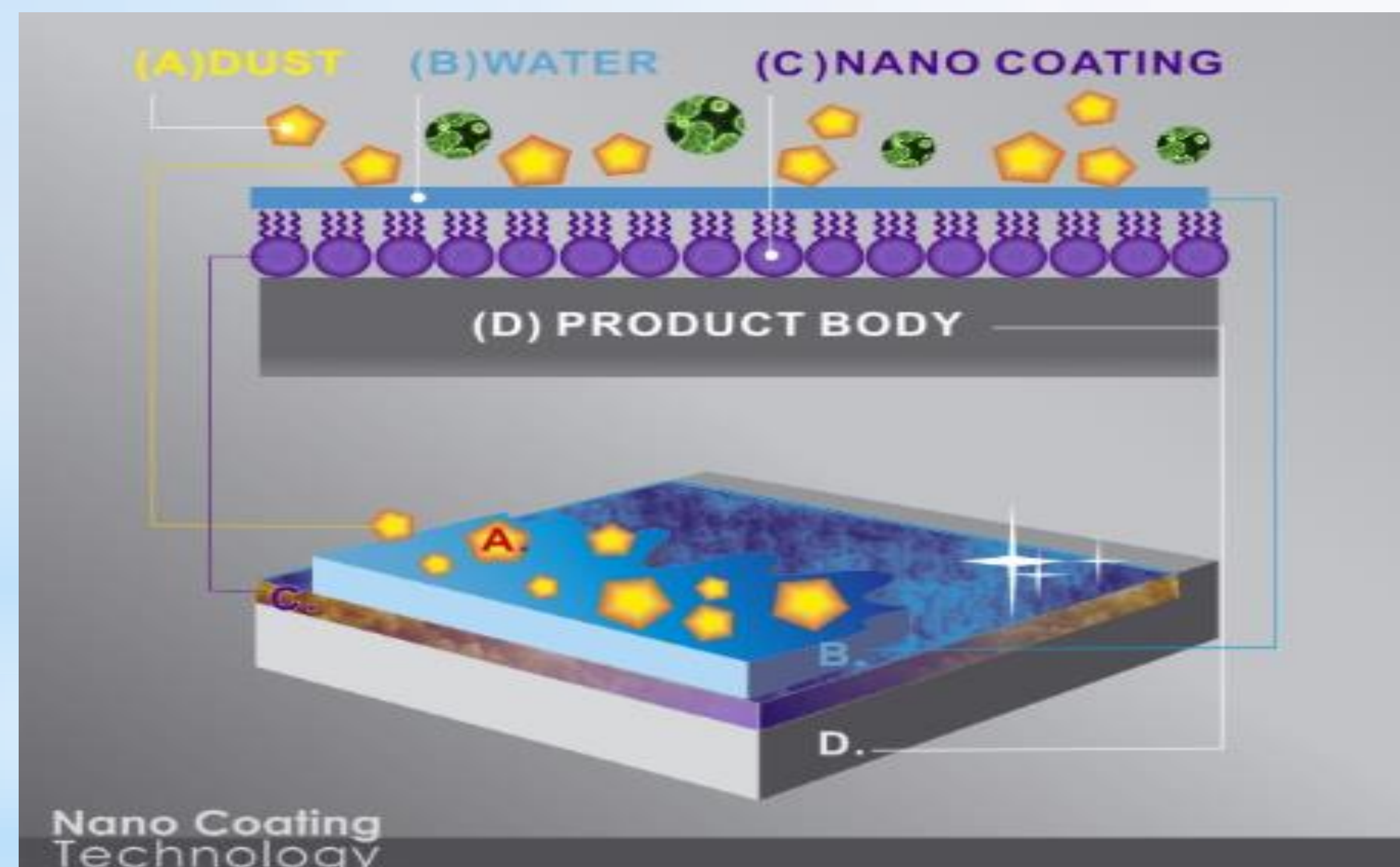


Figure 1: Nano coated surface [3].

Problem

- Current materials used to make cell phones such as polycarbonate, acrylonitrile butadiene styrene, lithium, fiberglass and epoxy cannot resist liquid damage [4].
- One of the behaviors that threatens almost all dynamic systems is fatigue which is the phenomenon of a component failing under variable loading prior to its reaching ultimate stress [5].
- People who live next to roads have a 10% higher chance of having a heart attack, stroke, arrhythmia, and asthma due to road pollutants[6].

Solutions

- Nano-composite coating is able to combine the softness of organic “phase” and the advantages of rigidity of inorganic “phase” which results in much higher functionality of the material [7].

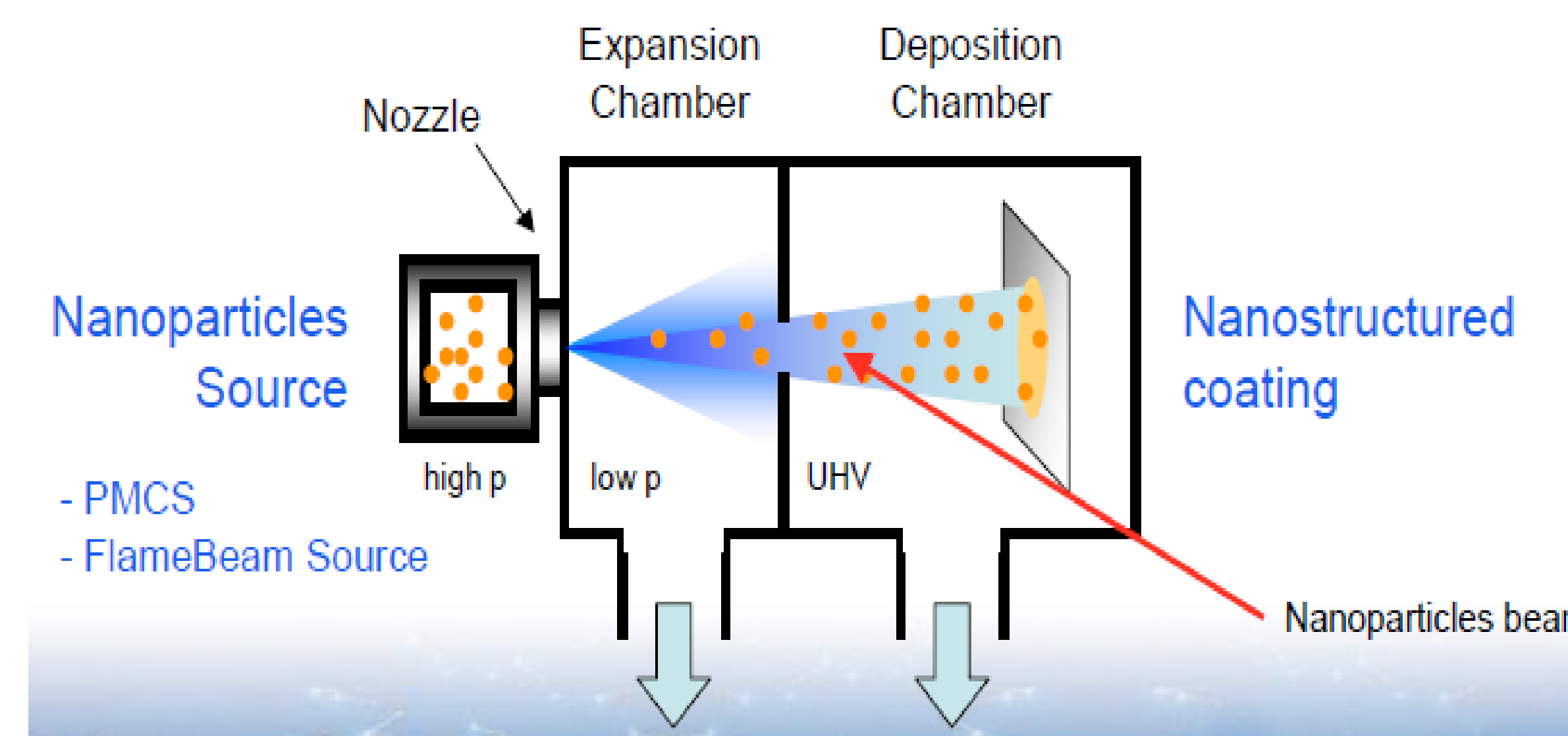


Figure 2: The process of nano-coating [8].

- Standard materials like steel can be enhanced with a thin layer of nano-coating to improve their properties and their resistance to fatigue failure.
- Pavements can be coated with nano-coating materials such as TiO₂ coating. The photo catalysis process of TiO₂ coating reduces road gas pollutants such as NO by 90% [9].

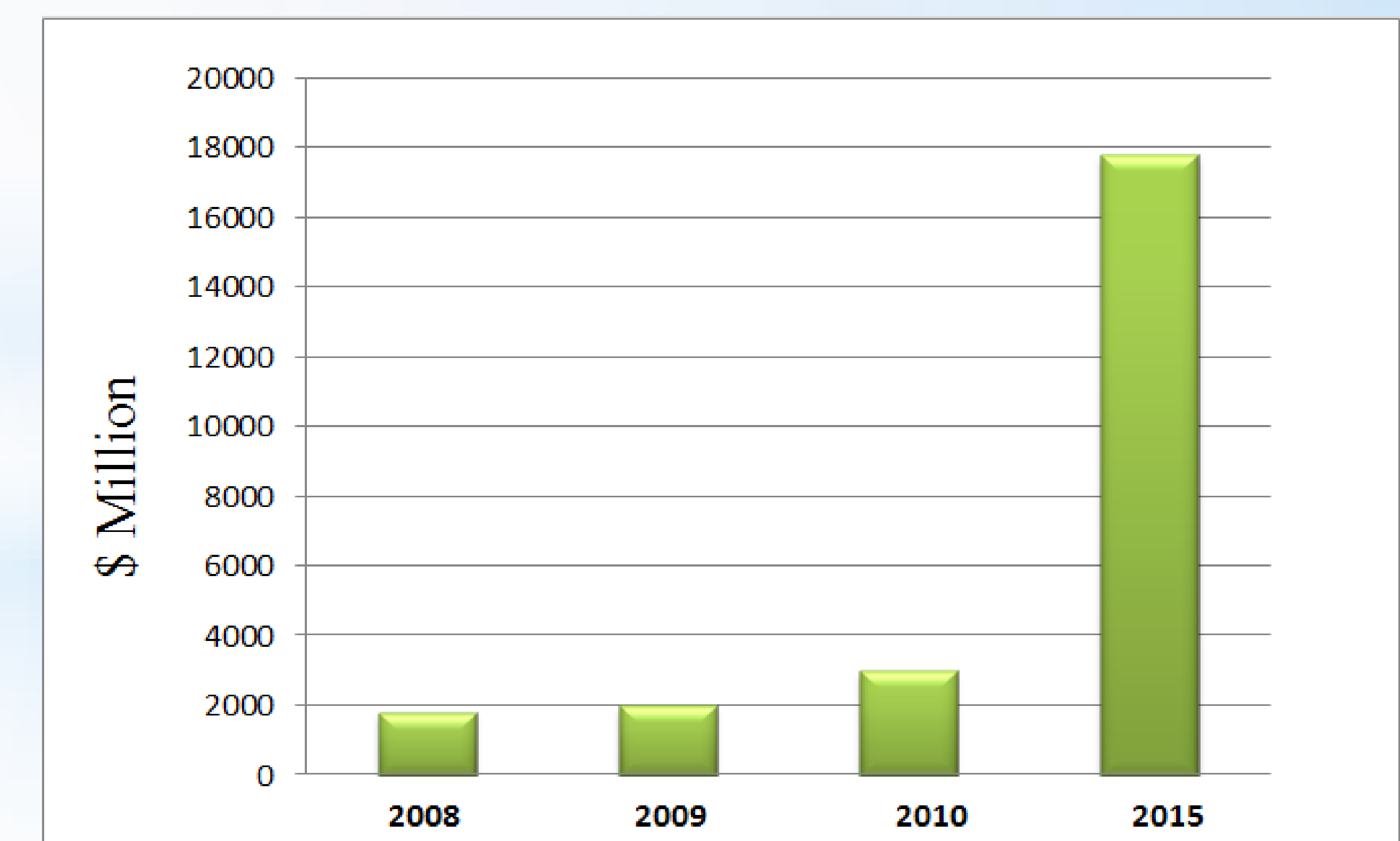


Figure 3: Nano coating of concrete [10].

Evaluation

- Nano-coating has not yet been fully developed. There is a need for expertise and high-tech machines for the technology of nano-coating to be used more widely to reduce current high cost.
- There is a tradeoff between the increasing cost of this technology and the effectiveness in reducing the weight and the usage of material. On the other hand, the cost of this technology is expected to fall as it spreads in the global market (Table 1).
- TiO₂ coating has less durability than mixing since it exposed to dynamic movement of vehicles tires.

Table 1: Global Market for Nano Coatings (2008 – 2015) [11].



References

- [1] “Infographic: The P2i Process,” *P2i.com*, n.d. [Online], Available: <http://www.p2i.com/download>. [Accessed: Nov 8, 2014].
- [2] M. Hassan, L. Mohammad, S. Asadi, H. Dylla, and S. Cooper, “Sustainable Photocatalytic Asphalt Pavements for Mitigation of Nitrogen Oxide and Sulfur Dioxide Vehicle Emissions,” *Journal of Materials in Civil Engineering*, vol. 25, no. 3, pp. 365–371, 2013.
- [3] “Liquid Armor Plus,” n.d. [Online], Available: http://www.dynaflousa.com/product_info.php?products_id=147
- [4] S. Yasir, “Improving the fatigue life of steel bars by using Nano-coating technology,” *International Journal of Engineering & Technology*, vol. 3, no. 4, pp. 523–528, 2014. [Online]. <http://www.sciencepubco.com>. [Accessed: November 22, 2014].
- [5] Bollinger, L. A., Davis, C. B., & Nikolic, I. (2013). An agent-based model of a mobile phone production, consumption and recycling network.
- [6] A. Khan, “Stay Off the Road: Traffic Pollution May Hike Heart Disease Risk,” *EverydayHealth.com*. [Online]. Available: <http://www.everydayhealth.com/heart-health/stay-off-the-road-traffic-pollution-may-hike-heart-disease-risk.aspx>. [Accessed: 12-Dec-2014].
- [7] Shuxue, Z., & Limin, W. (2009). Development of Nanotechnology-Based Organic Coatings.Composite Interfaces, 16(4-6), 281-292. doi:10.1163/156855409X447101
- [8] “Nanopowders and Nanostructured Coatings:Technologies and Products,” n.d. [Online]. Available: http://www.tethislab.com/docs/090520_tethis_technology_products.pdf [Accessed: Nov 15, 2014].
- [9] S. Shen, M. Burton, B. Jobson, and L. Haselbach, “Pervious concrete with titanium dioxide as a photocatalyst compound for a greener urban road environment,” *Construction and Building Materials*, vol. 35, no. 0, pp. 874–883, Oct. 2012.
- [10] J. V. S. de Melo, G. Trichês, P. J. P. Gleize, and J. Villena, “Development and evaluation of the efficiency of photocatalytic pavement blocks in the laboratory and after one year in the field,” *Construction and Building Materials*, vol. 37, no. 0, pp. 310–319, Dec. 2012.
- [11] Nanotechnology in Coatings and Adhesive Applications, “allwin-global.sg, August 1st, 2014. [Online] Available: http://allwin-global.sg/?page_id=713. [Accessed: November 8, 2014].