Inorganic Fullerene Coating For Medical Devices

(No. T4-1566)

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Overview

Implantable or insertable medical devices must be made of materials with unique properties in addition to biocompatibility to address potential damage from the physiological environment and to maintain their effectiveness over time. For instance, urethral medical devices (e.g., catheters) are damaged by the encrustation of minerals from the urine, which results in their frequent replacement. Various medical applications suffer from excessive friction, severely compromising their function leading to prolonged treatments. Prof. Tenne and his team developed a novel method for coating medical devices using inorganic fullerene-like nanoparticles to increase their lubricity and prevent encrustation. This coating is applicable for various devices such as stents, catheters, dialysis tubes, cannulas, and sutures.

The Need

Implantable or insertable medical devices must be biocompatible and possess specific mechanical properties depending on their designated use. In addition, they should also be resistant to potential damage by the physiological environment to ensure their long-lasting effectiveness. In the case of urethral medical devices (e.g., catheters), their exposure to calcium and phosphate ions from the urine results in the formation of crystals on the biomaterial surface, a process known as encrustation. Encrustation may cause infections and harm the medical device's functionality, resulting in its frequent replacement, which is inconvenient to the patient and costly. Also, excessive friction severely compromises the insertion and retrival of medical devices from narrow constrictions in the body, and leads to pain and morbidity of the paitent. In this context, one of the field's major goals is to search for new products that would generate less friction during insertion and retrival of catheters, endoscopes and laproscopes through narrow natural and purposely cut constrictions in the human body. Additionally, coating of endodontic files (EFs) used for root canal treatment can benefit from this technology as well. Finding a way to reduce file breakage during root canal treatment would greatly influence the costs of treatment and the prognosis of treated teeth stages and conditions. Therefore, there is a need for an efficient, general coating method to increase lubricity, thus preventing encrustation and reducing friction.

The Solution

Prof. Reshef Tenne and his team developed a novel method for coating medical devices to reduce friction and increase lubricity using inorganic fullerene-like nanoparticles (IFâ€‘WS2, IF-MoS2) [1,2]

Technology Essence

Fullerene-like nanoparticles (i.e., IF-WS2, IF-MoS2) are deposited on top of medical devices and change their surface properties dramatically. These nanoparticles produce coating films with a relatively small tendency to agglomerate. This architecture, together with the low affinity of the nanoparticles towards the environment (due to

closed-caged moieties which lack dandling bonds), results in their superior lubricity.

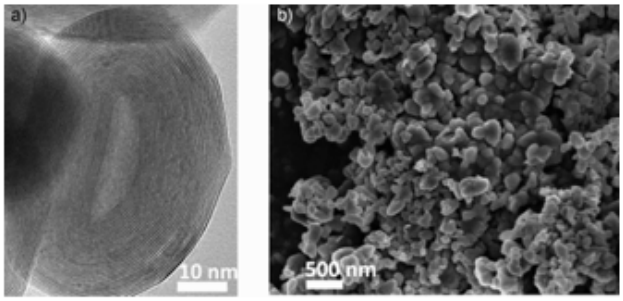
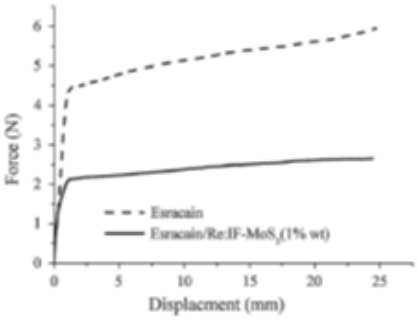


Figure 1 - a) TEM image of a single (smaller than the average size) IF-WS_2 nanoparticle, and b) SEM micrograph of agglomerated WS_2 nanoparticles with fullerene-like structure.

Fig. 2. Reduction of tranction force (friction) for an endoscope inserted through tiny constriction, by adding IF-MoS_2 nanoparticles to esracain.



Applications and Advantages

Applications

- Coating implantable or insertable medical devices such as stents; catheters; dialysis tubes; cannulas; and sutures

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Advantages

- Non-toxic
- Cheap
- Can be easily applied to existing medical devices
- Biocompatible - initial tests in animals suggest safety from toxic effects

References

1. Adini AR, Feldman Y, Cohen SR, et al. Alleviating fatigue and failure of NiTi endodonticÂ files by a coating containing inorganic fullerene-like WS 2Â Â nanoparticles. J Mater Res. 2011;26(10):1234-1242. doi:10.1557/jmr.2011.52 [1]

2. Goldbart O, Yoffe A, Cohen SR, et al. New Deposition Technique for Metal FilmsÂ Containing Inorganic Fullerene-Like (IF) Nanoparticles. ChemPhysChem. 2013;14(10):2125-2131.ndoi:10.1002/cphc.201201003 [2]

Patent Status

USA Granted: 11,446,413