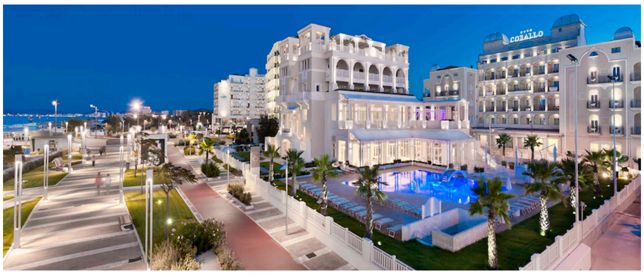

Contribution ID: **49** Type: **oral**

Vertically-Aligned Carbon Nanotubes as effective platforms to kill bacteria

Thursday, 8 June 2023 10:30 (20 minutes)

We propose and demonstrate a strategy for the design of highly antimicrobial surfaces with vertically aligned carbon nanotubes (VA-CNTs), also known as CNT forests, synthesized by means of an easy, low-cost and fast (~15 min) chemical vapor deposition process (CVD). The resulting VA-CNTs, uniformly covering the underlying growth substrate, are characterized by a high packing density forcing their vertical orientation. However, the great parallelism between CNTs terminates with a not-aligned top crust layer composed by entangled CNTs extending over the surface of the forest [1]. We show, via a combination of microscopic and spectroscopic techniques, the ability to finely shape this crust of CNTs in a controlled and time-efficient manner, by means of plasma etching processes, thus enhancing VA-CNTs antibacterial properties [2].
In particular, we investigate the antimicrobial power of three different varieties of VA-CNTs against *Pseudomonas aeruginosa* and *Staphylococcus aureus*: as-grown, and after two different etching treatments. The highest reduction of cell viability (100% and 97% for *P. aeruginosa* and *S. aureus*, respectively) was observed for VA-CNTs modified through Ar and O_2 as etching gas, thus identifying the best configuration for a VA-CNTs-based surface to inactivate both planktonic and biofilm infections. Additionally, this work sheds light on the mechanism responsible of this exceptional antimicrobial activity of CNT forests, pointing out that it occurs due to the mechanical interaction between the bacterial cell walls and the nanotube structures, which are capable of 'skewering' or 'smothering' the bacteria and, simultaneously, producing high levels of ROS, thus preventing the formation of microbial colonies. We firmly believe that the here proposed synthesis process, involving the CVD growth of CNT forests followed by the subsequent tuning of their nanomorphology through plasma etching, is an effective, rapid and low-cost route for engineering antibacterial coatings for a wide range of applications, such as biomedical devices, filtering systems for hospital, solid–air/liquid interfaces in healthcare units where biofilms usually appear.

References

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Session Classification: S5: Applications & X-Rays