A Graphene-based biosensor to detect the Sars-Cov-2 virus

Daniele Di Marino

Department of Life and Environmental Science, Marche Polytechnic University, Via Brecce Bianche, 60131, Ancona, Italy
New York-Marche Structural Biology Center (NY-MaSBiC), Marche Polytechnic University, Via Brecce Bianche, 60131, Ancona, Italy

ABSTRACT

The SARS-CoV-2 is a positive-strand RNA Betacoronavirus, responsible for the current pandemic diffusion of atypical pneumonia called COVID-2019. One important aspect of this syndrome spread is related to the small respiratory droplets that are free to travel in the air, likely being the primary mode of virus transmission. This is particularly alarming in the indoor environment of public places. Considering this, a system able to detect the viruses travelling directly in the air would be highly desirable. Our idea is based on replicating into a biosensor what normally happens in nature: SARS-CoV-2 can infect the human cells through interaction with the ACE2 receptor, through a spike protein. Our computational preliminary data about ACE2/RBD interaction have provided us a strong theoretical basis for the realization of the idea. The biosensor will be composed of a graphene-based chip that is widely used and validated in the field of biosensors. To detect the whole SARS-CoV-2 particle our innovative idea is to functionalize the graphene-based biosensor with the portion of ACE2 that interacts with high affinity with SARS-CoV-2 spike protein, instead of using antibody. ACE2 receptor will be firstly covalently immobilized onto the device through PBASE linker and secondly, we will exploit a new functionalization strategy to specifically orient the receptor on the graphene surface, through the formation of ACE2-DNA chimera and a subsequent hybridization between complementary DNA probe bound to PBASE. This innovative approach could increase sensitivity and could maximize the signal of the biosensor. The electrical performance of the biosensor will be evaluated using firstly the recombinant RBD portion of SARS-CoV-2 spike protein, and then using clinical samples from real patients.