Titolo: Empowering UV Led technologies for high-efficiency disinfection: from semiconductor-level research to SARs-Cov-2 inactivation

Codice Progetto: 2022YW793M

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Durata: 28/9/2023 - 27/09/2025 (24 mesi)

Budget totale progetto: 264.243 €

Budget UNIPD: 121.760 €

Abstract del progetto: The SARS-CoV-2 pandemic has shown that UV-based sterilization methods, alternative to conventional chemical techniques, are needed to inactivate viruses in large environments, like classrooms, planes, and hospitals.

Conventional UV-emitters (mercury tubes) cannot be widely adopted, due to their large size, low efficiency, short lifetimes, and complex disposal procedures due to Hg content.

Challenges with UV LEDs

This poses a challenge in the electronic engineering field. In fact, UV LEDs are the best alternative, but their efficiency is still low (especially for UVC, <5 %),due to semiconductor- and device-level issues that need to be solved before the potential of these devices can be fully exploited:

-high densities of dislocations and point defects limit the quantum efficiency of the LEDs

-carrier transport/injection are made difficult by the large binding energy of the doping atoms

-the ability of extracting light is hindered by lack of transparent contacts

-the reliability of UV LEDs is below the expectations

Challenges with virus inactivation

In addition, virus inactivation protocols based on UV light still have to be defined, and a substantial effort is needed to develop high-intensity UV LED lamps for sterilization.

Preliminary studies demonstrated that UVC light can effectively inactivate SARS-CoV-2, but several questions remain unanswered:

-what doses/irradiation times are necessary to inactivate the virus?

-can longer wavelengths (in UVB/UVA range) be effective?

-what is the difference between continuous and pulsed illumination for virus inactivation?

General goal, ambition, novelty

The goal of this project is to substantially contribute to the development of high-efficiency UV LED emitters, and to investigate the use of UV LEDs for virus inactivation. For the first time, will use a bottom-up approach, from semiconductor fabrication/research, to device modeling, to illuminator design, to testing in the field.