



UNIONE EUROPEA  
Fondo Sociale Europeo



Ministero dell'Istruzione,  
dell'Università e della Ricerca



PON  
RICERCA  
E INNOVAZIONE  
2014 - 2020



UNIVERSITÀ  
DEL SALENTO

Borsa di dottorato aggiuntiva del Programma Operativo Nazionale Ricerca e Innovazione 2014-2020 (CCI 2014IT16M2OP005), Fondo Sociale Europeo, Azione I.1 "Dottorati Innovativi con caratterizzazione Industriale"

## Innovative air and surface purification processes through functional treatments based on metal nanoclusters

Codice Borsa:

CUP: F85F21005880001

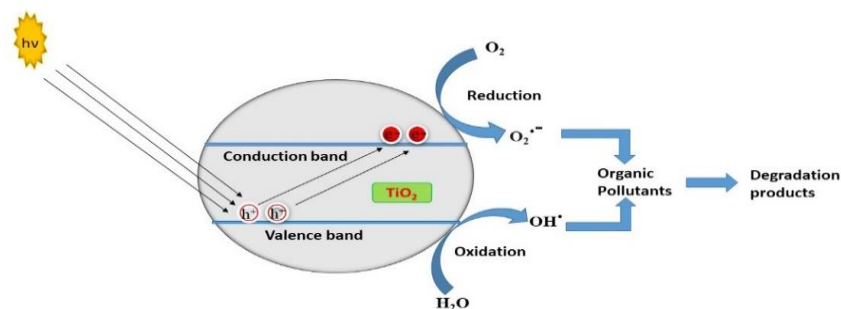
### Corso di Dottorato di Ricerca in Ingegneria dei Materiali, delle Strutture e Nanotecnologie – XXXVII Ciclo

Dottorando:  
**Amruth Kaitheri**

Tutor:  
**Prof. Antonio Licciulli**

Coordinatore:  
**Prof. Alfonso Maffezzoli**

Air pollution is one of the major threats faced worldwide for the safety and livability of the interior spaces. Due to the new coronavirus, SARS-CoV-2, a major global health crisis has emerged which demands the purification of indoor air extended to the neutralization of viruses and bacteria. In this current work, we aim to develop innovative metal/metal oxide coupled to semiconductor photocatalysts and metal oxide nanoclusters with excellent antimicrobial activity via suitable methods for surface purification processes. The antibacterial/antiviral activity of copper (CuNPs) and silver nano particles (AgNPs) and the principle of photocatalysis could be effectively utilised here. It is always important to select the best nanocluster for the effective air pollution treatment. Titanium dioxide (TiO<sub>2</sub>) and tungsten trioxide (WO<sub>3</sub>) nanoparticles earn some separate attention due to their photocatalytic properties. Photocatalysis is the process by which the rate of a chemical reaction can be increased by exposing the system to light (artificial or natural) and this can be utilized to degrade organic and other contaminants in air and water more effectively and fast. Here we would like to combine the biocidal characteristics of nanostructured Cu and Ag with photocatalytic materials like TiO<sub>2</sub> / WO<sub>3</sub>.



Photocatalysis mechanism

The United States Environmental Protection Agency (EPA) designated copper as the first metallic antibacterial agent in 2008. Nanostructured Copper based coatings will be prepared and antibacterial, antifungal, and antiviral activity will be investigated. Copper, (CuNPs) and silver nano particles (AgNPs) that have been immobilized or entrapped are of great interest. The biocidal properties of metal nanoparticles will be used to destroy bacterial, viral, and fungal contaminants by contact killing mechanism. The synthesis of a metal coupled with a metal oxide nano cluster will be carried out by using sol-gel, combustion, or solution mixing methods. Different metals, like tungsten, copper, silver, etc., are to be stabilised with an appropriate metal oxide. Stabilizing agents such as polyvinyl pyrrolidone, polyvinyl alcohol, will be tested to improve the adhesion between substrate and nanoparticles and the samples thus prepared will be characterised using FTIR, UV, XRD, FESEM, TEM. The samples will be tested for their air and surface purification efficiencies by photocatalytic experiments and biological properties by anti-bacterial and anti-viral tests. Finally, the material will be integrated into a device for the application as a surface purifier in limited resource settings. An appropriate prototype of this purifier will be modelled in collaboration with nanohub and the Institute of Technology, Sligo.



Biocidal action

## NANO HUB

NANOHUB is an innovative start-up born in 2018 with the aim of developing solutions based on the employment of innovative nanomaterial for the energy efficiency and the environments' quality, for people's wellness and the food products' protection and conservation. Nanohub's continuous research has led to the patenting of the innovative **KtV** (Kill the Virus) filter which accelerates the natural process of photocatalysis by up to 20 times, **eliminating viruses and bacteria** and other pathogenic substances. The NANOHUB devices with the application of the new patented filter therefore allow to pursue the objectives of improving indoor air quality and maintaining it, while at the same time allowing the containment or slowdown of the transmission of SARS-CoV-2.

## ITS Sligo

Institute of Technology Sligo (ITS), Sligo, Ireland.

The institute opened in 1970 as a Regional Technical College, and adopted its present name on 7 May 1997. The first students graduated with degrees from Sligo RTC in 1986. Brendan McCormack has been president of the institute since September 2016. IT Sligo has developed a number of distance learning options, and as of 2016 reportedly had 1,800 online learners registered on various online programmes. Since then this has increased to approximately 3000 online learners. In technology, IT Sligo's "Team Hermes" won the software design category of the 2011 Microsoft Imagine Cup (a world student technology competition, held in 2011 in New York).