3D printed composite materials with antifouling properties for aquaculture applications

Andrianna Bouranta [1], Ioan Valentin Tudose [1], Luciana Georgescu [1], Nikolaos Rafail Vrithias [2,3], George Kenanakis [2], Efsevia Sfakaki [4], Nikolaos Mitrizakis [4], George Strakantounas [4], Nikolaos Papandroulakis [4], Cosmin Romanitan [5], Cristina Pachiu [5], Oana Tutunaru [5], Lucian Barbu -Tudoran [6,7], Mirela Petruta Suchea [1,5,*] and Emmanouel Koudoumas [1,*]

[1] *Center of Materials Technology and Photonics, Hellenic Mediterranean University, Heraklion 71410, Greece;*

[2] *Institute of Electronic Structure and Laser, Foundation for Research & Technology-Hellas, Heraklion 70013, Greece;*

[3] *Department of Materials Science and Technology, University of Crete, Heraklion 70013, Crete, Greece*

[4] *Institute of Marine Biology, Biotechnology and Aquaculture, Hellenic Centre for Marine Research, Heraklion 71500, Greece;*

[5] *National Institute for Research and Development in Microtechnologies (IMT-Bucharest), Bucharest 023573, Romania;*

[6] *Electron Microscopy Center "Prof. C. Craciun", Faculty of Biology & Geology, "Babes-Bolyai" University, 400006 Cluj-Napoca, Romania;*

[7] *Electron Microscopy Integrated Laboratory, National Institute for R&D of Isotopic and Molecular Technologies, 400293 Cluj-Napoca, Romania*

Aquaculture is an industry of particular importance internationally, providing significant protein to an ever-increasing world population and offers the largest percentage of seafood consumed by humans. Its production infrastructure is based on a complex variety of components submerged in water, such as cages, nets, floats and ropes. However, all of these components are surfaces available for biofouling, as they provide the possibility of accretion in a wide variety of marine organisms, which acts as a source of parasites, and therefore has significant economic consequences. Current technology for preventing biofouling is based on the use of toxic, biocide-containing materials, which is a serious threat to marine ecosystems, as they affect both the targeted organisms and the environment around them. The purpose of this research is to develop alternative materials, which should be environmental friendly and combine low cost, durability, ease of production and efficiency for aquaculture applications. In recent years, there has been a strong interest in photocatalytic materials, such as TiO_2, because of their support to antifouling, self-cleaning and antibacterial action. TiO_2 seems to be one of the most active materials for photocatalytic action, as it also shows great stability due to its good resistance to corrosion.

Here we report on the development of new composite materials for aquaculture nets, using Acrylonitrile Butadiene Styrene (ABS)/TiO_2 and High-Density Polyethylene (HDPE)/TiO_2 with different metal oxide contents, so that the final material has antifouling properties, but also suitable mechanical behavior. The sample nets were developed employing extrusion and 3D printing, the obtained materials being characterized by SEM, XRD and Raman Spectroscopy, while, their antifouling properties were also evaluated. The antifouling response was determined by monitoring the prevention of growth of *Navicula* sp. diatoms and the monocellular algae *Chlorella* sp. on them. The results so far have shown that the HDPE/TiO_2 are quite good candidates for antifouling nets.

Acknowledgement: This work was funded by the Operational Program Fisheries and Maritime 2014–2020 in the framework of the project "Innovative materials for nets for fish farming with environmentally friendly antifouling action", MIS 5029684.

* mirasuchea@hmu.gr and mira.suchea@imt.ro; koudoumas@hmu.gr