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Project code: **COFUND-LEAP-RE-NANOSOLARCELL** Contract no. **293/2022**

Integration of Photonic Conversion Layers Based on Photoemissive Nanostructured Materials for Improving Sunlight Harvesting Ability of Solar Cells

Stage scientific report

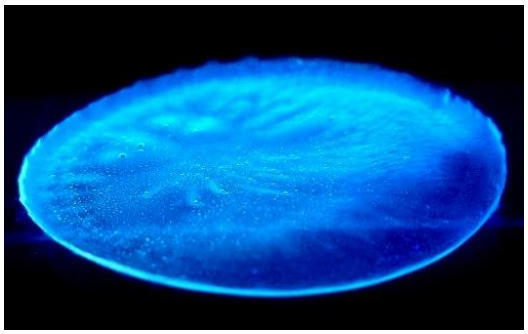
Stage 2

01.01.-31.12.2023

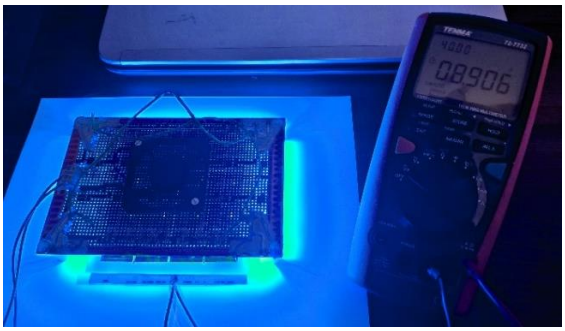
The studies carried out in this stage of the research project aimed both at obtaining carbon nanostructures of the Carbon Dots type (CNDs) from natural sources and the improving the photoemissive characteristics of CNDs prepared from NHF. A primary objective of the LEAP-RE consortium is the exploitation of local natural resources of the involved countries. Following the tests performed, CNDs with high photoluminescence emission were prepared using the waste from the cold pressing of argan oil. The obtained CNDs were morpho-structurally investigated, highlighting the notable characteristics of photoluminescent emission. Nanocomposites obtained by introducing CNDs into polymer matrices were prepared which were later processed into thin layers with the role of photonic conversion media applied to increase the conversion yields of solar PV cells by harvesting the UV component of the solar spectrum. Following the experimental studies, two copolymers PSA (polystyrenecoacrylonitrile) and COC (cycloolefinic copolymer) were selected, being prepared nanocomposites with intense photoluminescent emission, by introducing CNDs into these polymer matrices. Both prepared nanocomposites show excellent optical transparency, and in the case of COC-CNDs, an exceptional resistance to environmental factors and long-term exposure to sunlight were highlighted. In both cases, a significant improvement of the photon conversion yields was noted compared to those recorded for CNDs dispersed in selected solvents. Also, in both cases, thin layers of excellent quality are obtained that can be easily processed by spray coating techniques. A new type of CNDs with intense emission in the green zone of the visible spectrum was prepared by doping them with elements from the transitional groups. The new CNDs allow the translation of the UV component of solar radiation into a spectral zone where solar PV cells have a high sensitivity, thus increasing the conversion efficiency. In this stage, the photonic conversion layers based on the polymer complexes with intense emission in the green and red zone of the visible spectrum, prepared in the previous stage of the research project, were optimized. Preliminary tests carried out on solar PV panels provided with photonic conversion layers based on polymer complexes indicate an improvement in conversion yields by approx. 1.5%.

M(III) doped CNDs with green emission

CNDs prepared from argan waste



COC-CNDs nanocomposite
under UV excitation



Preliminary testing of a PV solar panel provided
with photonic conversion layer

Conclusions:

During Stage 2 (2023) of the research project, new types of carbon nanostructures with photoluminescent emission in the blue and green area of the visible spectrum were obtained and investigated. CNDs from argan waste were prepared and morpho-structurally investigated. A new type of CNDs doped with M(III) with emission in the green zone of the visible spectrum was also obtained. The introduction of CNDs into a series of suitable polymer matrices was studied, two copolymers being selected: cycloolefinic and polystyrene-co-acrylonitrile. Nanocomposites were prepared by introducing CNDs into the selected copolymer matrices. The prepared nanocomposites show remarkable photoemissive properties, being at the same time processable in thin layers with high optical transparency that can be implemented as photonic conversion media for increasing the conversion efficiency of solar PV cells.

Submitted manuscript:

C. S. Stan, N. Elouakassi, C. Albu, M. C. Ania, A. Coroaba, L. E. Ursu, M. Popa, H. Kaddami, A. Almaggoussi, *Photoluminescent argan waste derived Carbon Nano Dots embedded in polymer matrices as photonic conversion layers for solar PV cells*, MDPI-Nanomaterials, art id.2758350, 2023.