Doctoral School in Materials, Mechatronics and Systems Engineering

Research subjects proposed for the 39th cycle

Materials Science and Engineering (area A)

- Reference person: L. Fambri

Title: Phase change composite materials for thermal storage and passive cooling applications A8)

The objectives of this research project, funded by Eni S.p.a., concern the study of known and/or innovative systems and materials aimed at reducing and/or solving specific problems presented by some conditions of use of solar cells for photovoltaic energy production through passive cooling systems and thermal energy storage.

In fact, photovoltaic power production is negatively affected by solar cell temperature, since only a fraction of the radiation is converted into electricity, while the rest is absorbed mainly in the form of heat, raising the module temperature up to 70°C. For silicon-based solar cells, this means a 3.5-5% reduction in efficiency for every 10°C increase in temperature. Since higher temperatures occur when insulation is higher, this is a limiting factor on daily energy production, especially in very hot climates.

Cooling systems to reduce solar cell operating temperatures and improve PV module performance are known as active and passive cooling systems. Considering the constraints for the exploitation of the technology (system design, retrofitting, cost, durability, material compatibility, external stability, etc.) one of the most promising passive cooling technologies seems to be that based on Phase Change Materials (PCMs). PCMs are capable of storing and releasing thermal energy through state change. As the temperature changes, they continuously move from solid to liquid state and vice versa. They can be composed of different types of matter and are mainly distinguished between organic and inorganic PCMs. Several PCM-based systems will be selected and prepared with direct characterization of thermal effectiveness in both heating and cooling, with a view to application on panels. In coordination with industrial companies, the research results will be appropriately evaluated for the realization of devices and systems for use in both conventional and possible innovative solar cells.

In accordance with the company policies of the funder (Eni S.p.A.), the grant will be conditional on the doctoral candidate signing a declaration of compliance.

The candidate for the selection and award of the grant in question must therefore meet the following additional requirements:

-not having been subject to or not being subject to investigations and/or precautionary measures (misure cautelari) and/or committals for trial (rinvio a giudizio) and/or conviction measures (provvedimenti di condanna), even if not final, and/or sanctions for criminal conduct (condotte penalmente rilevanti) including violations of anti-corruption and/anti-money laundering laws;

The candidate must also declare:

-to have read and be aware of the content of the Code of Ethics Eni, the MSG Anti-Corruption and the Declaration of Eni on Respect for Human Rights" published on the website Eni and to share their principles, committing to comply with them during the course of the PhD in question;

-not to have any relationship of affinity or kinship with a Public Official (as defined in Eni's Anti-Corruption MSG) who, by virtue of the role held, may be involved in activities in which the Lender (Eni S.p.A.) or its subsidiaries have a concrete and relevant interest;

-not to have any conflict-of-interest situation, not even potential, with Eni or its subsidiaries.