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Germanium-based hybrid photovoltaics

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Electricity is needed in many situations of our daily life at many different locations around the globe. Solar energy has the major advantage that the conversion process light/energy is simply available during daylight. It does not have to be actively transported or stored and is free of political control. Therefore, a strong interest in solar energy conversion has manifested over the last decades with solar cells taking the role of converting solar energy to electricity.

Hybrid solar cells are a promising technique for future energy generation as they combine the advantages of organic and inorganic solar cells. Organic materials are solution processable. Thus, they enable large scale and cheap production with little energy demand. They also allow for thin film devices sparing scarce resources. Furthermore lightweight and flexible cells are suitable for new applications. On the other hand the usage of inorganic material provides high charge carrier mobility and avoids degradation, which enhances HPV lifetime stability.

Starting from an organic solar cell, the main objective is to incorporate an inorganic component into this structure in order to make a hybrid photovoltaic device. In this case, we use a wet chemical precursor for the germanium layer. First for this work, we focus on an inverted geometry system, which includes an additional compact titania blocking layer (figure 1). Therefore, the approach is to characterize and optimize every step of this organic system, especially the active layer which strongly influences the efficiency of the solar cell. Thus, its morphology needs to be optimized and a homogenous film is desirable. In order to achieve this, we investigate the different layers using several techniques such as an optical microscope (figure 2), UV-Vis (figure 3), Dektak, and a solar simulator. With these facilities, we are able to enhance our way of working, and thus in short term to integrate the germanium layer into it as the electron conductive film.

Primary author: GUELLE, Fabien (E13)

Presenter: GUELLE, Fabien (E13)

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