The project is devoted to the development of new materials that will be used in perovskite solar cells. Devices of this type belong to the latest technology, which made a breakthrough in PV few years ago, in the field dealing with the conversion of solar energy into electricity. In a short time, the efficiency of perovskite cells increased nearly six-fold from 3.9% in 2009 to 22.7% in 2017. Perovskite cells are the most promising of all third generation cells and can replace silicon solar cells in the future. Their biggest advantage is that they achieve high efficiency using low-temperature and relatively simple technologies. Therefore, the price of 1 W of electricity produced from this type of cells may be lower in comparison to other technologies. Another advantage is that the bandgap can be controlled by changing the chemical composition. For this reason, the perovskites are very well suited for tandem cells, e.g. with silicon or with CIGS.

Perovskite solar cells belong to the thin-film cells, where the absorber is perovskite, most often methylammonium lead iodide, obtained as a result of simple chemical synthesis. The main advantage of perovskite cells is the fact that their production usually uses uncomplicated methods that do not require the use of special equipment. Thin layers, as well as a transparent front electrode, cause the cells to be semi-transparent, and depending on the chemical composition of the perovskite, they can assume different colors. Thanks to this, they can find application in the future not only in photovoltaic power plants where they would be a much cheaper alternative to classic silicon cells but also in architecture or motorization. The only disadvantage of currently produced perovskite cells in the laboratory scale is the lack of stability, which mainly depends on the perovskite itself. As it is known, methylammonium lead iodide is very sensitive to moisture, UV radiation and also elevated temperature Only if this problem is resolved the implementation for production will be enable.

In addition to the perovskite layer, which is an absorber, there are other layers in the cell that act as transporters of positive (hole) and negative (electron) carriers to the electrodes. These layers can have a destructive effect on the perovskite, as well as themselves can be decomposed. Particularly unstable is HTM, which is most often an organic material with an amorphous structure. The most popular of the holes transporting materials is the so-called Spiro-OMeTAD, a small-molecule organic compound, which should be additionally doped with lithium in order to obtain a sufficiently high conductivity. All record high efficiency is achieved for this type of material. Its disadvantage, however, is the very high price resulting from many complicated processes during its synthesis. In addition, the used dopants absorb moisture, which leads to perovskite degradation. Therefore, intensive research is being carried out in many laboratories around the world, which are currently focused on improving the stability of cells. The intensity of research is demonstrated by the exponential increase in the number of papers published from only 3 in 2009 to 3150 in 2017, according to the Web of Science database. In publications over the last two years, certain strategic paths have been identified that may lead to increased stability. The first way is to replace the methylammonium cation (MA) in the base perovskite $MAPbI_3$ with several cations, and the iodine anion by the mixture of iodine and bromine ions. The second approach involves the creation of multidimensional structures in perovskite by implementing 2D structures in 3D perovskite. Thus, the project proposes developing methods for the production of modified halide perovskite and holes transporting material (HTM). Synthesized perovskites will be characterized by the presence of a mixture of methylammonium, (MA), formamidium (FA), guanidinium (GA) or cesium (Cs^+) cations with various molar proportions. These works refer to the last research directions, which are extremely promising for improving perovskite stability. HTM organic materials will be synthesized in one simple process. The goal will be to develop HTMs with sufficiently high conductivity that do not require doping. If, on the other hand, this assumption is not achieved, then hydrophobic admixtures will be developed which, unlike lithium, will not lead to perovskite decomposition.

The ecological aspect is very important from the point of view of the future mass production of perovskite cells. Because highly toxic solvents such as chlorobenzene and dimethylformamide currently are used for high efficiency perovskite cells, it is very important to replace them by less toxic green solvents. The project will carry out research on finding environmentally friendly green solvents. The investigations will be be carried out on the effect of these solvents on the process of crystallization of perovskites, their morphology as well as the electrical parameters of cells.