# FLUORENE-BASED HOLE TRANSPORTING MATERIALS FOR EFFICIENT AND STABLE PEROVSKITE SOLAR CELLS

Šarūnė Daškevičiūtė[1], Nobuya Sakai[2], Marius Franckevičius[3], Marytė Daškevičienė[1], Artiom Magomedov[1], Egidijus Kamarauskas[4], Vygintas Jankauskas[4], Henry Snaith[2], Vytautas Getautis[1]

[1] Department of Organic Chemistry, Kaunas University of Technology, Lithuania
[2] Clarendon Laboratory, Department of Physics, Oxford University, United Kingdom
[3] Center for Physical Sciences and Technology, Lithuania
[4] Institute of Chemical Physics Vilnius University, Lithuania
sarune.daskeviciute@ktu.lt

Solid-state organic hole transporting materials (HTMs) are one of the important components of the perovskite solar cells (PSCs), ensuring stability of the perovskite absorber layer, good charge separation, and as a consequence high performance of the devices. Currently, Spiro-OMeTAD is the most popular choice for the HTM layer, and is used for the majority of the state-of-the-art PSC devices. However, due to the complicated multi-step synthetic procedure, price of the Spiro-OMeTAD remains at a very high level. However, it is not only quite expensive but also shows unsatisfactory long-term stability due to oxidative doping process and slow morphological degradation [1].

In this work, novel small-molecule HTMs **V1050** and **V1061** were designed and synthesized (Fig.1). Synthesis was performed using a facile three-step synthetic route, starting from simple fluorene derivatives. The coplanar central core was chosen in order to improve the efficiency of HTM, as was previously shown by Li and co-workers [2]. As a hole transporting fragment, 4,4′-dimethoxydiphenylamine 3,6-disubstituted carbazole was used, due to its good performance in PSCs [3]. The synthesized compounds exhibit amorphous nature with a high glass transition temperature, a good solubility, and decent thermal stability.

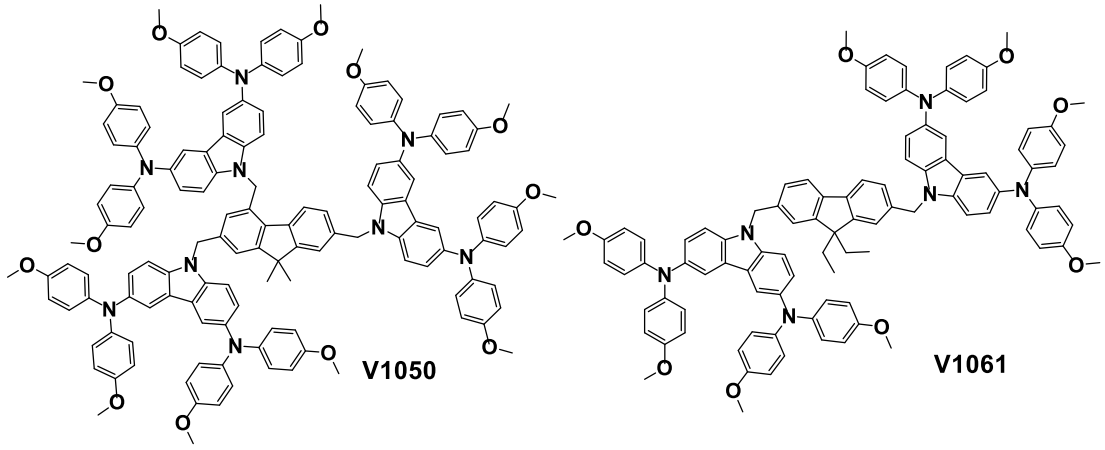


**Figure 1**. Structures of fluorene-based HTMs **V1050** and **V1061**.

PSCs of planar configuration, employing **V1050** HTM showed a high power conversion efficiency of 18.3%, which is comparable to the 18.9% efficiency, obtained in the same device configuration, only using Spiro-OMeTAD as a HTM. In addition, devices with **V1050** and **V1061** showed better stability in comparison to Spiro-OMeTAD based devices. Aging test was performed on a non-encapsulated devices under uncontrolled humidity conditions (relative humidity around 60%) in the dark and under continuous full sun illumination. Overall, we believe that the **V1050** can be a usefull alternative HTM to Spiro-OMeTAD for perovskite solar cells, thus bringing PSCs closer to commercial production.

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[2] W.-J. Chi, P.-P. Sun, Z.-S. Li, A Strategy to Improve the Efficiency of Hole Transporting Materials: Introduction of a Highly Symmetrical Core, Nanoscale **8**, 17752-17756 (2016).
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