# Synthesis and investigation of new organometallic semiconductors containing dimethoxydiphenylamine-substituted carbazole fragments

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Perovskite solar cells (PSCs) have attracted a lot of scientists attention, since their power conversion efficiency (PCE) has increased from 3.9% to 23.9% over the last decade. The main material in these photovoltaic devices is perovskite, which benefits from simple synthesis, from inexpensive precursors and such beneficial properties as sufficiently high conductivity and wide light absorption [1].

The energy conversion efficiency mostly depends on the hole transporting materials (HTMs), which also can influence the stability of whole photovoltaic device. The most commonly used organic HTMs, such as well-known spiro-OMeTAD, often require complex and expensive synthesis; furthermore, majority of the best efficiency results were achieved using additives (dopants), such as *tert*-butylpyridine, lithium bis(trifluormethanesulfonyl)imide and as a consequence these devices usually suffer from long-term stability issues [2].

Organometallic HTMs benefit from simple one or two-step synthesis procedures and usually can be purified by quick and inexpensive methods avoiding column chromatography. Moreover, organometallic nature of the semiconductors can provide additional advantageous properties, consequently these compounds may be used as dopants-free HTMs [3].

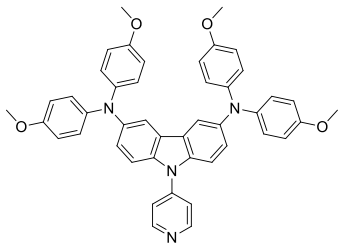

**Fig. 1**. Structure of precursor **P1**

In this work, AgTFSI, CuTFSI and $Cu(TFSI)_2$ organometallic semiconductors were synthesized using $N^3$,$N^3$,$N^6$,$N^6$-tetrakis(4-methoxyphenyl)-9-(pyridin-4-yl)-9*H*-carbazole-3,6-diamine (**P1**) as a precursor (**Fig. 1**).

The best results with dopants were achieved using $Cu(TFSI)_2$-based organometallic compound (**Fig. 2**) – the maximum power conversion efficiency reached 18.14%. The dopant-free PSC based on CuTFSI organometallic complex reached respectable PCE of 13.13%.

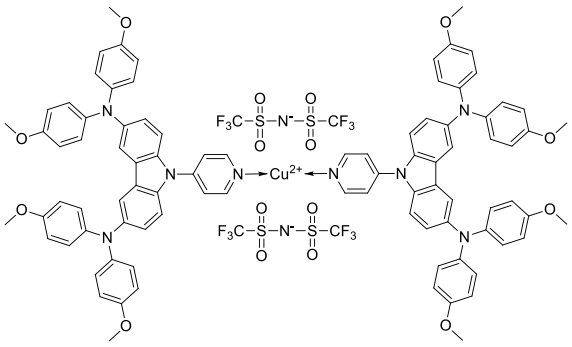

**Fig. 2**. Structure of $Cu(TFSI)_2$-based organometallic complex

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