



## Semiconducting $\pi$ -extended discotic liquid-crystalline triindoles: studying their FET vs SCLC mobilities

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### SUMMARY:

The field of organic electronics has experienced a vast development in the last few years, having the first generation of devices based in this technology already reached the market. Advances achieved in this field have been associated with the research of organic semiconductors able to transport charge carriers with a high mobility. However, finding organic semiconductors with the right balance between mobility and processability is still a challenge in the area. In this context, discotic liquid crystals, constituted by an aromatic central core surrounded by flexible alkyl tails, are among the most promising new candidates.

Triindoles have been widely studied as a  $\pi$ -conjugated platforms in the construction of high mobility semiconducting liquid crystals. Three-fold oxidative cyclodehydrogenation of hexaphenyltriindole renders the significantly enlarged aromatic core, with structural characteristics of both triphenylene moieties and triindole. In this  $\pi$ -extended discotic core, the attachment of three flexible alkyl chains to the nitrogen atoms is sufficient to induce mesomorphism. The ratio of conducting versus isolating fraction is impressively enhanced when comparing to triindole liquid crystals, not only by enlarging the size of the central core but also by reducing the amount of isolating peripheral chains.

In this presentation the electrical properties of the aforementioned semiconductor have been analyzed by applying two different methods: space-charge limited current (SCLC) measurements in a diode-like structure and field effect mobility measurements in a thin film transistor device. The mobility found on

a diode type device is higher than that determined on thin film transistors, which can be understood by the high tendency of large  $\pi$ -conjugated molecules to deposit on surfaces with their extended core parallel to the substrate. This is demonstrated with a full analysis of the active layer of the thin film transistor, in order to analyze the molecular orientation in the semiconductor-dielectric interface, via Surface Enhanced Raman Spectroscopy (SERS). The observation of field effect behavior in a discotic liquid crystal processed by simple drop-casting suggests an increased dimensionality of charge transport by facilitating hopping between neighboring columns as a result of the large conducting/isolating ratio found in this discotic platform. Density Functional Theory (DFT) calculations have been performed in order to enlighten with more detail the charge-transport parameters at a molecular level.

#### References:

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