High mobility *n*-type organic thin-film transistors deposited at room temperature by supersonic molecular beam deposition

F. Chiarella[1], T. Toccoli[2], M. Barra[1], L. Aversa[2], F. Ciccullo[1], R. Tatti[2], R. Verucchi[2], S. Iannotta[3], and A. Cassinese[1]

[1]CNR-SPIN and Physics Department, University of Naples, Piazzale Tecchio 80, I-80125 Naples, Italy
[2] IMEM-CNR-FBK Division of Trento, Via alla Cascata 56/C, I-38123 Povo, Italy.
[3] IMEM-CNR, Parco Area delle Scienze 37/A, I-43124 Parma, Italy.

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In this paper, we report on the fabrication of N,N_0-1H,1H-perfluorobutil dicyanoperylenediimide (PDIF-CN_2) organic thin-film transistors by Supersonic Molecular Beam Deposition (SuMBD). The devices exhibit mobility up to 0.2 cm^2/V s even if the substrate is kept at room temperature during the organic film growth, exceeding by three orders of magnitude the electrical performance of those grown at the same temperature by conventional Organic Molecular Beam Deposition (OMBD)(see Figure). The possibility to get high-mobility n-type transistors avoiding thermal treatments during or after the deposition could significantly extend the number of substrates suitable to the fabrication of flexible high-performance complementary circuits by using this compound.

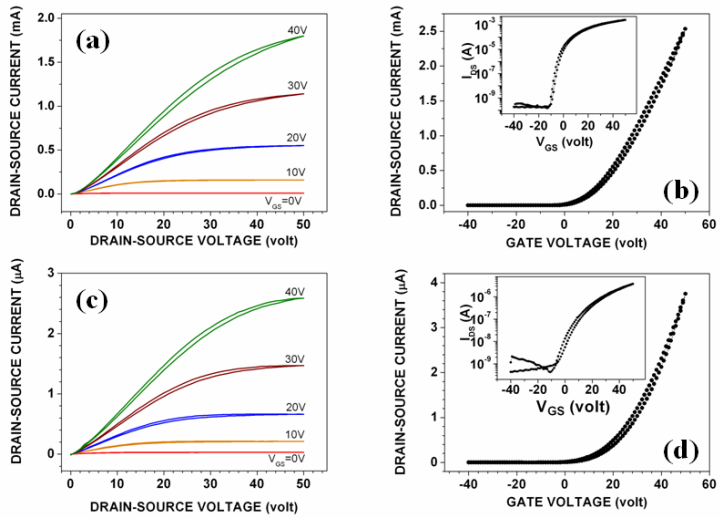

Figure: Output and transfer-curves in the saturation regime measured in vacuum for PDIF-CN_2 transistors fabricated by (a), (b) SuMBD and (c), (d) OMBD techniques on HMDS-treated Si^{++}/SiO_2 substrates. In the inset of (b) and (d), semi-log plots of the transfer-curves are shown.

Applying the SuMBD technique to the PDIF-CN_2 compound, we demonstrated that the kinetic energy (E_k) enhancement of the depositing molecules is an effective route to get n-type layers with good structural and electrical properties, even when the substrate is kept at room temperature during the deposition. Beyond the appealing applicative interest of this result, the possibility to combine E_k and T_{sub} should open the possibility to more accurately control the growth mode of PDIF-CN_2 films, commonly exhibiting structure polymorphs when deposited by OMBD at high T_{sub} (140 °C).