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Control of Channel Conductivity of Rubrene Single Crystal Field Effect Transistors. CHRISTIAN KLOC, MAGNUS WIKBERG, WOO-YOUNG SO, DAVE V. LANG, THEO SIEGRIST, ARTHUR P. RAMIREZ, Bell Laboratories, Lucent Technologies — Carrier mobility higher than 1 cm^2/Vs has been measured in numerous organic single crystal FETs, making them interesting for microelectronic applications. The understanding why some organic pi-electron systems show high mobility and others, very similar molecules, show much lower mobility is crucial for design of efficient and robust organic semiconductor devices. It seems that transistor properties measured on FETs are extrinsic properties limited by technology used for transistor fabrication. However, to evaluate the applicability of organic semiconductors, intrinsic properties need to be assessed. We have carried out a program to purify and grow low defect density single crystals and fabricate FETs on their surfaces. Using graphite as electrodes and parylene as an insulator we measured maximal mobility in rubrene of 13 cm^2/Vs and significant anisotropy of transport properties. To control the transistor properties, we chemically modify the channel area and measured the conductivity of transistor channels before covering it with dielectrics and gate electrode. We found that the channel area of rubrene is very sensitive on reduction and oxidation and that the transistor properties may be modified by performing chemical reactions on the crystal surfaces before finishing transistor structure..

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