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Field-induced polymorphous disorder and bias-stress instability of pentacene organic thin-film transistors MASAHIKO ANDO, Hitachi Cambridge Laboratory, CLAUDIA DUFFY, JESSICA WINFIELD, Cavendish Laboratory, TAKASHI MINAKATA, Asahi Kasei R&D Center, HENNING SIRRINGHAUS, Cavendish Laboratory — We propose a field-induced polymorphous disorder model to explain bias-stress instability in pentacene organic thin-film transistors Field-effect mobility at 0.7 cm^2/Vs and threshold voltage, Vth, at 0 V were obtained by using highly crystalline zone-casted pentacene semiconductor on benzocyclobutene insulator. Vth shifted up to +25V with positive gate bias-stress at +40 V for 15 hours and recovered after gate bias removal. Vth recovery was drastically accelerated by direct photo-excitation of pentacene and it indicated electrons were trapped in pentacene and not in BCB. After annealing at 130 C in N2, the initial electrical performance were recovered. Micro-Raman spectroscopy of pentacene at the channel revealed that shape of the C-H vibrational peaks at around 1160 cm^{-2} changed reversibly in accordance with the positive shift and recovery of Vth. Our pentacene films with average d-spacing at 14.3 A were considered to be composed of a mixture (mosaic) of two kind of polymorphs with d-spacing at 14.1 A and 14.5 A. The polymorphous mixture should be disordered by electric field to create electron traps and induce Vth shift.

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