

The Bipolar Field-Effect Transistor Theory^{*,**}

(A. Summary of Recent Progresses)

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Abstract

Field-effect transistor (FET) was conceived 80 years ago in Lilienfeld's 1926-1932 patents [1]. Shockley-1952 [2] invented the volume-channel FET 55 years ago using two opposing p/n junctions as gates on the two surfaces of a thin semiconductor film to control the conductance of the thin-film's volume-channel. Atalla-Kahng-1960 [3] demonstrated the surface-channel FET using a single conductor (metal)-on-insulator (oxide) as the gate (MOS or MIS gate) on thick silicon to control the surface-channel conductivity. The initial circuit design simulator SPICE [3] used the 1964-Sah constant gate threshold-voltage MOSFET model [4], improved for voltage-dependent gate threshold-voltage in 1966-Sah-Pao [5]. These are the 25% FET theory since they included only the drift current for one carrier species, missing the diffusion current and the second carrier species, electrons or holes. Diffusion current was included in 1966-Pao-Sah [6] to give the 50% or the Unipolar FET (UniFET) theory. We noticed recently (March 2007) the simultaneous appearance of both electron and hole currents in the experimental data of the latest nanometer dual-MOS gates on thin-base silicon FETs [7], which led us to the development of the 100% Bipolar Field-Effect Transistor Theory (BiFET). This paper summarizes the history and progresses presented in our monthly reports [8-14].

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