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Title:Peculiarities of surface breakdown in GaAs bipolar junction structures
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Abstract:An avalanching GaAs bipolar junction transistor can operate as an effective terahertz source or as a superfast voltage/current switch, with each unique function offering prospects for various applications. As the transistor is operating near its breakdown voltage, the most probable destruction mechanism is device shortening at the mesa surface caused by surface breakdown. This manifests itself in measured I-V curves as a soft increase in surface current within the voltage range lying well below the volume breakdown. Surprisingly, the mechanism of surface breakdown has not properly been investigated or interpreted, despite the long history of the problem. We show here by comparing experimental results with those of 2-D numerical simulations that the soft increase in the surface current is, in fact, a premature breakdown that is suppressed by impact-generated electrons trapped at the surface. These negatively charged surface traps cause expansion of the space charge region and reduce the peak electric field near the surface, thus drastically increasing the voltage range over which avalanching can exist at the surface without fatal current growth. This mechanism explains various peculiar features of surface breakdown and should be taken into account when analyzing device reliability, surface breakdown transients, or passivation methods. © 2010 IEEE.