Abstracts

Skin Effects in Narrow Copper Microstrip at 77 K

U.S. Ghoshal and L.N. Smith. "Skin Effects in Narrow Copper Microstrip at 77 K." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1788-1795.

We have performed finite element and circuit simulations to analyze the performance of copper polyimide wafer scale interconnects at 77 K as a function of line width, dielectric thickness, and line length. The copper line width was generally kept equal to the dielectric thickness; this is a realistic geometry which gives a characteristic impedance of about 60 Omega, but one which is difficult to analyze using analytical techniques. The finite element simulations were used to extract the frequency-dependent complex impedance which arises from the normal skin effect. This was then fitted to obtain an equivalent circuit which could be used in SPICE simulations. Anomalous skin effect was determined to be unimportant for frequencies below 20 GHz and was not included in the detailed finite element models. We have used these results to analyze the performance of these lines for digital interconnects and to identify possible applications that would benefit from still lower resistance, such as might be obtainable from the high temperature oxide superconductors. Skin effects were determined to be important for predicting the response for times less than 1.2 times the time of flight delay, while for larger instants the dc resistance corresponding to the cross section of the signal line is adequate.

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