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Highly Conductive Filament and Fermi-level Unpinning Effect for Ultra-Low Contact Resistance Achievement

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It is well known that contact resistance has been a critical issue in determining the performance of complementary metal–oxide–semiconductor (CMOS) reaching physical limits. Conventional Ohmic contact techniques, however, have hindered rather than helped the development of CMOS technology reaching its limits of scaling. Here, a novel conductive filament metal–interlayer–semiconductor (CF-MIS) contact which achieves ultra-low contact resistance is investigated for potential applications in various nanoelectronic devices in lieu of conventional Ohmic contacts. This universal and innovative technique, CF-MIS contact, forming the CFs to provide a quantity of electron paths as well as tuning Schottky barrier height (SBH) of semiconductor, is firstly introduced. The SBH of the semiconductor is lowered by inserting ultra-thin interlayers such as Al_2O_3, ZnO, and TiO_2. Those interlayers can unpin the Fermi-level by alleviating the metal-induced gap states (MIGS) at the semiconductor surface. Moreover, CFs are formed in the interlayers to significantly increase conductivity between the metal and the semiconductor. The proposed CF-MIS contact achieves ultra-low specific contact resistivity, exhibiting up to ~×700, 000 reduction compared to that of the conventional metal-semiconductor (MS) contact. This study proves the viability of CF-MIS contacts for future Ohmic contact schemes, and that they can easily be extended to mainstream electronic nanodevices that suffer from significant contact resistance problems.

Biography:

Seung-Hwan Kim received his B.S. degree in Electrical Engineering from Dongguk University, Seoul, South Korea, in 2014. He is currently pursuing his Ph.D. degree in School of Electrical Engineering from Korea University. His current research interests include CMOS technology and future memory.